WATER NEUTRAL GROWTH IN THE TOWN OF IPSWICH:

Integrating Land Use Planning and Water Conservation Strategies to Build Climate Resiliency for the Future

MAPC Accelerating Climate Resiliency Municipal Mini-Grant Project
December 2019
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IPSWICH RIVER WATERSHED ASSOCIATION

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SUMMARY

A clean and abundant water supply is society's most important resource. Unfortunately, this vital resource is often taken for granted, especially in historically water-rich areas such as the Northeast United States. This resource is increasingly under threat due to excessive and inefficient use, development patterns and climate change.

The Town of Ipswich municipal water supply is threatened by factors in common with many neighboring water systems as well as many that are unique to Ipswich. Current stressors to the municipal supply include physical supply limitations, quality concerns which affect the use of certain sources, and restrictions imposed by the State to reduce the impact of the withdrawals on the environment. The Town's water sources are located within watersheds that are classified as highly stressed by the State Water Resources Commission, and the Town is currently approaching its authorized withdrawal cap. Approval of increased withdrawals, as a way to address limitations, is unlikely. Moreover, all of these issues will be exacerbated by increased demand from future growth and development and the anticipated impacts of climate change.

To address these challenges, the Town of Ipswich Water Department pursued a Climate Resiliency grant from the Metropolitan Area Planning Council (MAPC) and partnered with the Ipswich River Watershed Association (IRWA) to undertake this study. The study explored and identified opportunities for the Town to achieve water neutral growth through the minimization of demand from new growth and development and offsetting that demand through the reduction of water use elsewhere in the community.

Major recommendations to help offset the additional demand from new development and increase the resiliency of the Town's limited water supply are:

- Implementation of a Water Use Bylaw to enact water-neutral growth policies and procedures, including development of a water use mitigation program (also known as a water bank).
- Completion of a comprehensive evaluation of the Town's development review bylaws, regulations and procedures to minimize the impact of new and existing development on the water balance of the Town's water resources.
- Development of a more comprehensive enhanced water conservation and use reduction program throughout all sectors of the community to help offset the additional demand from new development and increase the resiliency of the Town's limited water supply.

ACKNOWLEDGEMENTS

The Project Team included:

- Vicki Halmen, Ipswich Water & Wastewater Director, served as Town Project Lead
- Kristen Grubbs, Ipswich River Watershed Association Planner & Municipal Vulnerability Preparedness Provider, served as the Project Lead for the consultant
- Ethan Parsons, Ipswich Senior Planner, provided regulatory input and served as liaison to the Ipswich Planning Board
- Jim Engel, Ipswich Water Sub Committee Chair, provided overall project guidance and assistance
- Wayne Castonguay, IRWA Executive Director, provided project guidance and technical input

Many technical experts provided additional research, guidance and expert review throughout the course of the project, including:

- Michelle Craddock, Watershed Ecologist, MA Division of Ecological Restoration
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- Gabby Queenan, Policy Director, Massachusetts Rivers Alliance
- Sam Cleaves, Regional Coordinator, North Shore Sub-region, MAPC
- Anthonia Ogudipe, Tufts University and Intern for the Ipswich River Watershed Association
- Parker-Ipswich-Essex Rivers Restoration Partnership Steering Committee and Water Conservation Working Group
- Greenscapes North Shore Coalition partners

We would like to specifically recognize the Massachusetts Division of Ecological Restoration which conducted the critical Water Use Analysis (Appendix 9), participated in public presentations and contributed technical support throughout the project. We would like to thank all project participants for their participation and expert input and would like to commend the Metropolitan Area Planning Council's Climate Resiliency Program and Senior Environmental Planner Darci Schofield for their foresight in creating this program and making this project possible.

INTRODUCTION

The Town of Ipswich is a coastal community located at the confluence of the Ipswich River and Parker River Watersheds in northeastern Massachusetts. The Town's water supply derives from a combination of ground and surface water sources located in both the Ipswich and Parker River watersheds. In recent years, these water supplies have come under increasing threat due to supply limitations, increasing demand and impacts from current and projected climate change. Due to these threats, the resiliency of the Town's water supply is at risk and the Town has serious concerns over its ability to meet future water demand. These factors combined with aging infrastructure and deteriorating water quality in some of its sources put water supply within the top issues the Town is addressing.

With a population of approximately 13,200, the Town of Ipswich currently uses an average of 360 million gallons of water per year from its public water system. As was experienced during the drought of 2016, the Town is having difficulty meeting this demand during dry periods due to limitations of its water sources. These limitations are due to a combination of the modest physical yield of its sources and restrictions placed upon them by State water withdrawal regulations because of the environmental sensitivity of the watershed in which its sources are located. Moreover, despite having one of the more progressive water conservation and management programs in the region (Ipswich River Watershed Association, Personal communication), water use has been increasing in recent years and is inching closer to the cap under its State withdrawal permit. Over the next 20 years, the population of the Town is estimated to increase by approximately five percent and several large residential projects are in the planning stages which will put even more demands on the water supply.

Meanwhile, the changing climate brings the threat of more frequent and severe impacts on the water supply in the future. These trends are likely to bring more dry days and higher summer temperatures, thereby reducing the amount of water available for withdrawal in the environment (ResilientMA.org) and increasing customer demand. These conditions will impact the reliability of both public water sources and private wells, which also provide water for residential, agricultural and commercial purposes throughout town. Most significantly for Ipswich, irregular precipitation conditions and source limitations result in a public drinking water supply that is particularly vulnerable to drought. In 2016, the State of Massachusetts experienced the most severe drought since the US Drought Monitor began keeping records in 2000, lasting 48 weeks beginning on June 07, 2016 and ending on May 2, 2017 (Drought.gov). The most extreme drought conditions in the State were in the Northeast region, specifically the Ipswich and Parker watersheds when the Ipswich River experienced its longest low/no flow period since flow monitoring began in 1930 (Ipswich River Watershed Association). The Town of Ipswich declared an "Emergency (Stage 5) Drought", and the Massachusetts Department of Environment Protection (MassDEP) issued a "Declaration of State of Water Supply Emergency" to limit all non-essential water usage in Ipswich and to allow for pumping of water sources in excess of permitted levels. The 2016 Drought clearly demonstrated that the greatest concern of drought is typically between June and September—the same time as when public water usage is highest and the availability of water in the environment is lowest. To further exacerbate the challenge, climate change is also predicted to increase the rate of sea level rise in the not too distant future. As a result, both public and private wells located in the low-lying coastal areas in town are threatened by saltwater intrusion. The Town's recently

completed Coastal Adaptation Plan predicts that by 2100 the site of Brown's Well, the Town's most productive well will see regular inundation during periods of high tide.

To address these threats, the Town of Ipswich pursued a Grant from the Metropolitan Area Planning Commission's Climate Resiliency Municipal Mini Grant Program to fund this project. The goals of the project were:

1. Review the land use regulations and bylaws in the Town of Ipswich and develop recommendations for climate-smart, "net zero" water use revisions.
2. Research and develop a model "Water Bank".
3. Review, quantify, and recommend enhanced Water Conservation Strategies to both offset new water use and reduce current use to increase water supply resiliency.
4. Conduct public outreach during and after the project.

The outcomes of this project include:

1. Research on what more can be done to better manage and reduce the Town of Ipswich's current water use, and to minimize new demand.
2. Information to assist the development of an action plan for the Town.
3. Engagement and education of the Town's staff, boards and committees.
4. Engagement and enhanced communication with fellow water suppliers and regional partners working on water supply resiliency in the region.
5. Development of water use reduction tools that can also be used in other communities.
6. Enhanced climate resiliency for the Town of Ipswich and other communities.

Regional and Regulatory Context:

The threat to the reliability of the Town of Ipswich water supply is exacerbated by the regional context of its watersheds. The Town is located at the bottom of the Ipswich and Parker River Watersheds (also called the Ipswich and Parker basins) (Figure 1). Municipal water withdrawals from the two watersheds supply public water to communities located both inside and outside of the watersheds and serve a total of approximately 400,000 people (Horsley and Witten Inc., 2003). As is true in Ipswich, much of the Ipswich and Parker basins' regional water supply is provided by relatively small reservoirs and groundwater aquifers with limited storage that depend on reliable winter and spring precipitation for annual replenishment. The Ipswich and Parker Rivers and their tributaries suffer from perennial low flow conditions in the summer. This challenges the reliability of the overall supply in the basins, and also negatively impacts the river, its wildlife, recreational opportunities, and the overall ecosystem of the watersheds.

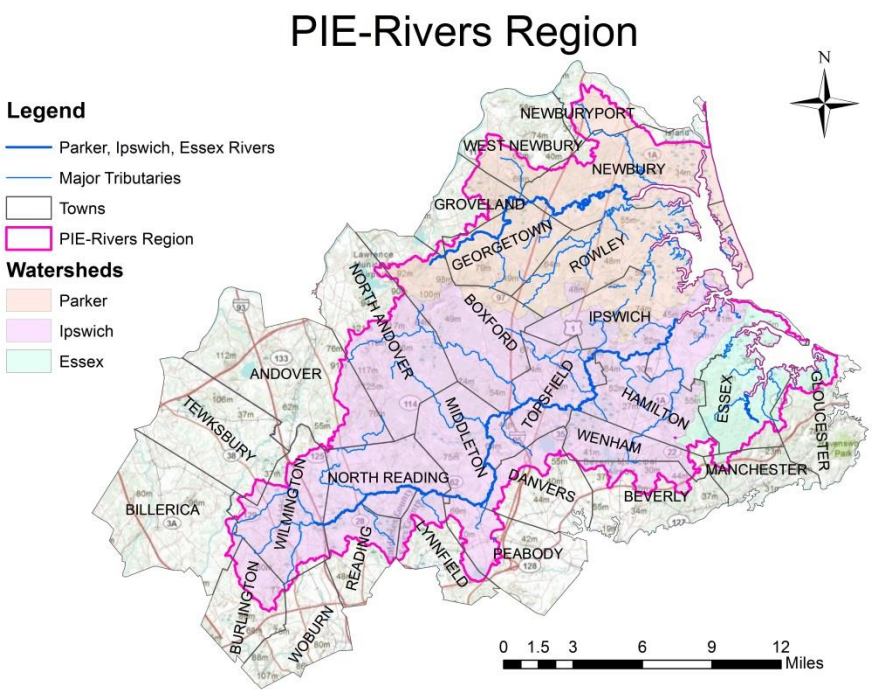

Figure 1: Parker, Ipswich and Essex Rivers (PIE) Watersheds

Across Massachusetts, the combination of precipitation deficits and high temperatures plus increasing water use and changing land use has caused new record low streamflow and groundwater levels in recent years. These changes have been documented by the State and more severe impacts from our changing climate are projected (Appendix 2).

In 2014, new regulations governing water withdrawals in Massachusetts under the Massachusetts Water Management Act were promulgated, placing increasingly challenging restrictions on local water suppliers. These regulations established the Safe Yield for the Ipswich River basin below existing authorized water withdrawals, which means that municipalities that withdraw from the Ipswich basin are now required to stay within or below existing withdrawals in perpetuity. Although the safe yield for the Parker River Watershed has not yet been reached, the new regulations may require that additional withdrawals from the basin be mitigated. Pursuing additional sources of water from neighboring communities is unlikely to be a viable alternative to replace and/or supplement its local sources. All four of its neighboring communities with public water systems (Rowley, Topsfield, Hamilton and Essex), two of which already share interconnections with Ipswich for emergency purposes, are subject to the same regulations and are located in equally stressed sub-basins. Its fifth neighbor, the Town of Boxford, does not have a public water system. As such, the Ipswich River Watershed Association considers the Town of Ipswich to be one of the least resilient in terms of water supply in the region.

As a result of the drought of 2016 in the context of these new regulations, six community public water suppliers in the Ipswich River basin began to work with the Massachusetts Water Works Association (MWWA) and consultants to improve understanding of the current and future water supply constraints. The project examined the challenges facing the basin's municipal public water suppliers—particularly those who are dependent on groundwater sources—and identified potential regional solutions that

could allow for improved resiliency and environmentally sustainable growth. A central conclusion of these studies was that existing constraints coupled with climate change significantly threaten the resiliency of the Ipswich Watershed water supply now and in the future. These studies (MWWA and Kleinfelder 2017 and 2018) conclude that these communities need to reduce existing demand, share water sources and pursue alternative and/or regional water supply solutions to increase water resiliency and to accommodate future growth and development. Since the studies were conducted, the Ipswich basin groundwater communities initiated a series of discussions which continue today, and State Senator Bruce Tarr has created an Ipswich River Drought Task Force to facilitate a dialogue to help address this challenge.

Faced with these current constraints and future challenges from climate conditions, the Town of Ipswich is engaged in these regional conversations, while simultaneously focusing on its own discussion of water needs, climate impacts, and resiliency. Recent discussions of these issues have extended beyond the municipal Water Department and the Water Subcommittee and the Water Commissioners (Select Board), to meetings of the Planning Board and the Zoning Board of Appeals; to public community meetings and a Water Forum; and to town social media discussions. Large subdivision and development proposals currently under review by the Town's permitting boards are shining a light on the town-wide concern about expanding water use, and some vocal individuals are advocating for a building moratorium until this issue can be addressed.

The community has been exploring ways to reduce existing water use to the maximum extent possible, especially during periods of lower water availability, and to minimize additional demand created by future growth and development. In 2017, the Town passed a water restriction bylaw to address community water use, establishing restrictions on private well usage consistent with those on the municipal supply to among other things help protect the shared aquifers supporting these withdrawals. In 2019, the Town completed a Municipal Vulnerability Preparedness (MVP) Planning Workshop, drawing diverse stakeholders together to identify the municipality's environmental, societal, and infrastructural vulnerability to climate change. The resultant Town's MVP Plan identified multiple water-related vulnerabilities, including supply, as a high priority concern.

Ipswich Water System and Use Profile

History: By 1889, the need for a proper water supply became evident in the community. Multiple meetings regarding the water supply proposal took place over several years. Despite the clear need, the matter was always voted down as it did not receive the two-thirds majority. In 1894 two fires destroyed large sections of downtown. This brought the people of Ipswich together to finally agree on installing a municipal water system. In 1895, the Town's first Water Works and cast-iron pipe system served a portion of what is now downtown Ipswich. Water was drawn from a new reservoir built on Dow Brook and pumped to a storage reservoir on Town Hill for distribution by gravity throughout the downtown area. Bull Brook was added as an emergency source of water at the time which has since been developed into a second active reservoir. The Town's Water Works has continued to expand, and now provides water to 4,500 customers, equating to 98% of the population.

Assets and Resources: Today's water distribution includes over 93 miles of distribution mains and eight miles of transmission mains with 700 fire hydrants. Water drawn from the Town's two reservoirs is treated at a water treatment facility. Water from its five groundwater wells is treated onsite prior to

being pumped into the distribution system. All aspects of departmental operation are handled in house with a 24/7 operational and emergency response capability. There are currently 10 full time employees, which are licensed in water treatment and/or distribution management. A Supervisory Control and Data Acquisition (SCADA) System is used to monitor the system and allows for both local and remote monitoring. SCADA collects data for important decision making and alerts operators to any issues, enabling faster response times. The Town recently replaced all of its customer water meters with Smart Meters and is in the process of making software and system upgrades to provide the ability for customers to access their data instantaneously and to further customize water bills for advisory and educational purposes.

Water quality is regulated by both the Federal Environmental Protection Agency and the Massachusetts Department of Environmental Protection. The six different sources are tested on a strict sampling schedule to ensure that the water quality continuously meets numerous parameters. Common concerns are lead, copper, and manganese. To help maintain water clarity and quality, regular hydrant flushing is utilized to clean iron and other mineral deposits from the water mains. The quality and quantity of surface water (reservoirs) and groundwater is further protected though the protection of land. By protecting the land around these sites water is absorbed into the ground which filters the water and decreases potential contamination (quality) and recharges the aquifer (quantity). This in turn reduces treatment costs. Studies have shown that a 10% increase in forest cover can yield a 20% decrease in water treatment costs (Ernst Gullick and Nixon, 2004).

The Town's six water supply sources consist of the Winthrop, Fellows Road and Essex Road Wells in the Ipswich River Watershed, Brown's and Mile Lane Wells and Bull and Dow Brook Reservoirs in the Parker River Watershed (Figure 2). In recent years, two of the Town's groundwater sources, including the largest and most productive have exceeded advisory levels of manganese (Mn). To maintain Mn below these levels, the use of these important sources has been reduced. As was seen during the drought of 2016, the Town's reservoirs cannot make up for the loss of the wells due to their small size. Thus, the Town's water supply flexibility and resiliency has been further strained in recent years. To provide additional operational and supply resiliency, redundancy and flexibility, the Town has embarked on a comprehensive water supply analysis to identify additional sources and to investigate additional treatment alternatives on its currently manganese-restricted sources. As part of this ongoing effort, the development of a potential new groundwater source is being explored in the Bull Brook sub-basin as well as installing manganese treatment at the Brown's and Fellows Road Wells or treating Brown's well water at the water treatment plant.

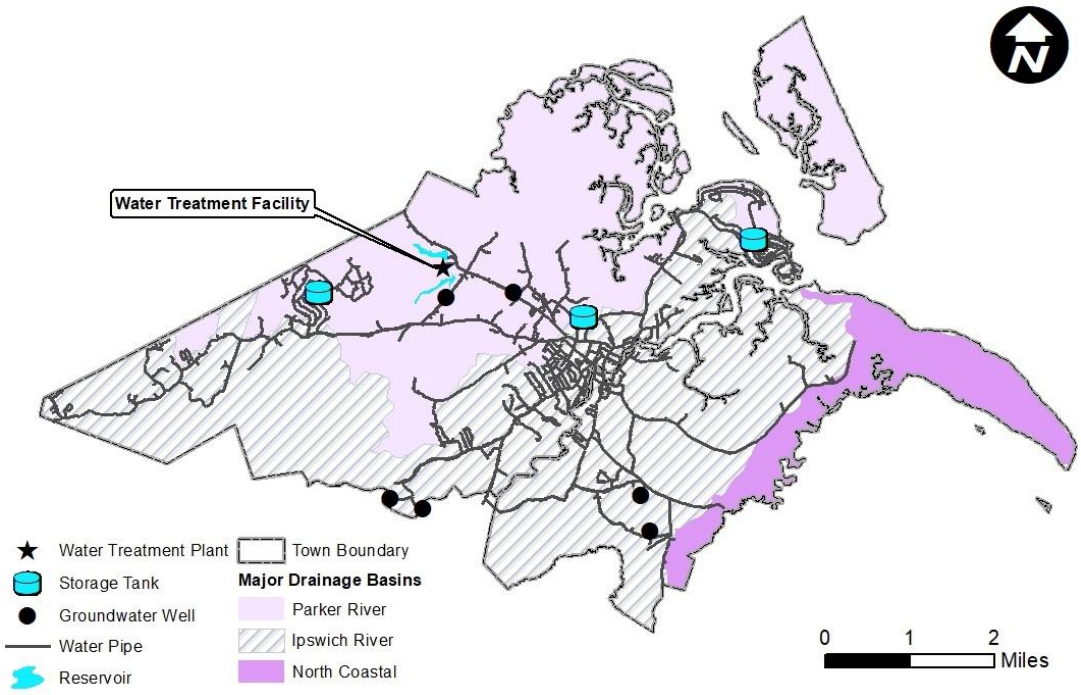

Figure 2: Location of Town of Ipswich Water Supply Sources

Water use in the Town peaked in the mid to late 1990's at nearly 450 million gallons per year. Following the implementation of a water conservation program, switching from quarterly to monthly billing, adoption of a residential seasonal rate structure and infrastructure repairs, water use declined to around 350 million gallons annually in 2014. Since that time, water use has increased every year due to an increase in both demand and water system breaks/leaks due to the system's advanced age. Several high water-use commercial developments have recently come on-line, and several large housing developments are in the development pipeline. Considering that Ipswich has approximately 3000 acres of developable land remaining in the community (Ipswich Open Space & Recreation Plan, 2013) planned and potential new development could soon exceed the Town's regulatory cap of 430 million gallons per year.

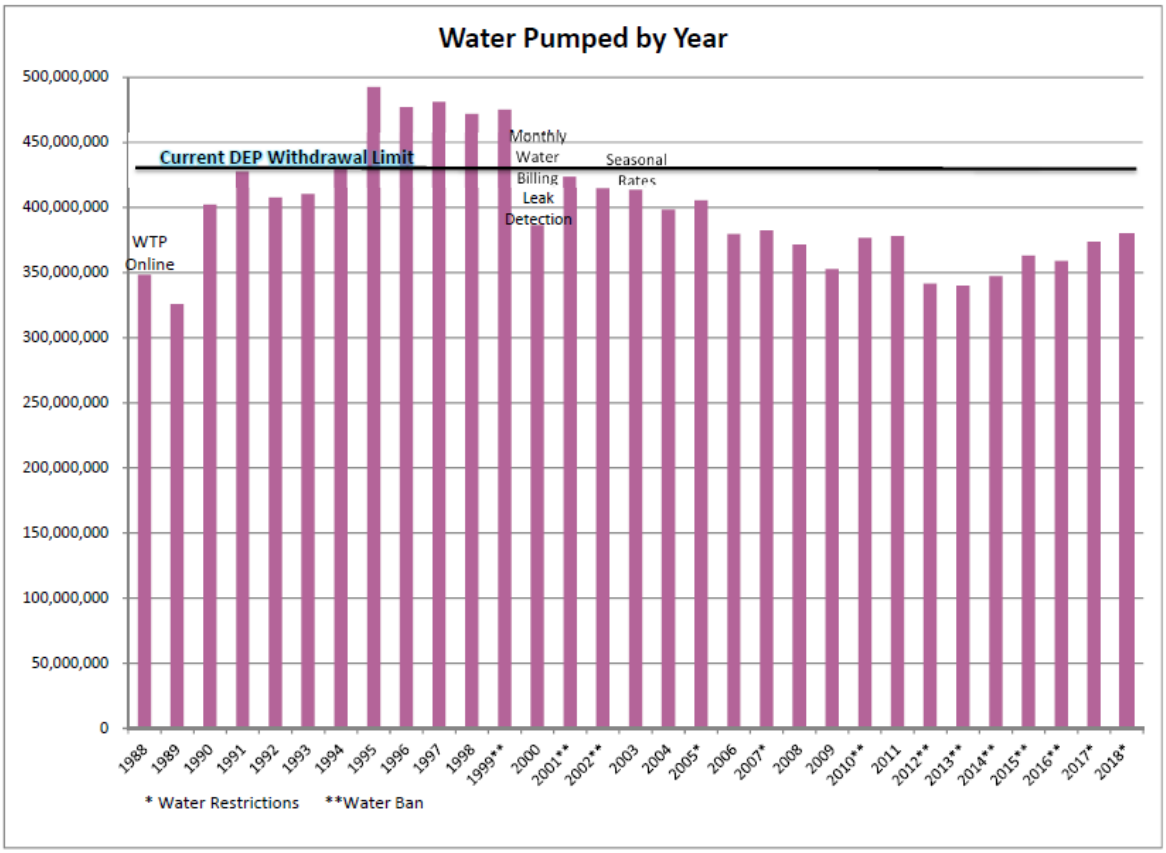

Figure 3: Water Use by Year 1988-2018

While the Town's overall annual water demand is a factor, daily, seasonal and source-specific use statistics are a much more important consideration. Like any town, summer use increases significantly over winter use and is currently about 1.4 times that of winter use. Due to their location and type of withdrawal (surface vs. ground), each water source can have varying degrees of operational constraints and environmental impact. In the summertime, use is often highest at the very time there is the least amount of water available to be withdrawn from the environment. During dryer periods, water supply can often compete with the needs of rivers and streams and the aquatic life and other human uses they support. Thus, reducing summertime withdrawals and/or finding less damaging alternatives may be desirable regardless of operational or permit withdrawal constraints.

Existing Water Use Reduction and Conservation Programs: The Town of Ipswich has put into practice multiple programs and methods to manage and reduce water consumption and water loss. The Town's Water Department has partnered with the EPA's WaterSense program and the regional Greenscapes North Shore Coalition Program to educate the public about water usage. Both programs provide informative materials and education programs that help people reduce their water use inside their homes and in their yards. The Water Department has also implemented several other methods to encourage users to decrease their water consumption. With smart meters installed on 100% of its customers and monthly billing (instead of the industry norm of quarterly or less) in place, it is easier for residential and commercial customers to understand just how much water they are using and spending on water. A seasonal rate structure is also used to encourage residential customers to decrease their summertime water consumption. Since 2003 the cost of water from May through September is

increased by 3X the winter rate (while being revenue neutral overall). These programs helped achieve the significant water reductions seen since the Town's peak water usage in the late 1990's.

To protect the Town's water supply, water use restrictions or bans are often put in place during the summer as part of its Drought Management Plan. These restrictions/bans apply to not only those who use public water, but to those with private wells as well since they often draw from the same aquifers and to aid in public acceptance of water conservation efforts by treating everyone the same. The Water Department also offers water audits to its residential and commercial customers. These audits are designed to help users address leaks and reduce other inefficiencies in their households, yards and businesses. The Town also promotes and subsidizes the installation of rain barrels and is a member of the Greenscapes Coalition which offers a myriad of educational programs and materials to the community on ways to conserve and protect water. The Ipswich Water Department has an extensive leak detection system in place which checks the entirety of the distribution system annually. Ipswich also performed a system wide audit in 2006. The Ipswich River Watershed Association considers the Town of Ipswich water conservation efforts above average relative to other water suppliers in the region.

OVERVIEW OF RECOMMENDATIONS

As a component of the Town's evaluation of ways to improve its overall water system resiliency, this report recommends additional steps to minimize new water demand from new development AND decrease existing demand so the community can meet the needs of future residential growth and economic development and increase supply resiliency. The strategies recommended by this project and summarized in the document herein are based upon a thorough review of the steps Ipswich has taken to date, what additional steps could be feasible in Ipswich and additional research to assess what more can be done. The recommendations of this report will require the involvement of much of town government as well as its citizenry and fall into four categories:

1. Land Use: Recommendations for Water Neutral Growth

Land use regulations and development patterns in Ipswich and in communities throughout the Ipswich and Parker basins are impacting water availability and demand. Recommendations aimed at "water-neutral growth" include: adoption of a new bylaw to require developments to offset their projected additional water demand; review of bylaws to find opportunities to require and/or incentivize low impact development practices and green infrastructure to reduce and minimize the impacts of development on the natural water balance and supply; and recommendations for water use minimization which boards and committees can use to condition development permits. All of these tools will enable the community to work towards water neutral growth.

2. Water Bank/In Lieu Fee: Recommendations for Water Use Mitigation Program (WUMP)

Water use mitigation mechanisms can reduce or offset the strain of new development on the community's water system. Other Massachusetts towns (including Ipswich watershed neighbors Danvers and Wenham) currently have water use mitigation programs. This report summarizes

the lessons learned by these communities, as well as from around the country and recommends that Ipswich adopt this tool.

3. **Water Conservation: Recommendations for Enhanced Water Conservation Strategies**

   While gains have been made toward reducing water use, there is more that can be done, especially in the summer when water use is the highest and there is the least amount of water available in the environment. The recommendations provided within this document provide additional opportunities for the Town to achieve increased water conservation results.

4. **New Systems and Procedures: Recommendations for New Programs, Collaborations and Capacity for Water Neutral Growth.**

   Implementation of the recommendations provided will require an increase in municipal capacity, a new regulatory paradigm and increased collaboration to achieve water neutral growth. While this will require additional resources to manage, much of it can be met via the use of existing tools and through optimization of regional coalitions and partnerships currently available to the community.

1.0 Land Use: Recommendations for Water Neutral Growth

Land use across a community and throughout its regional watershed has a direct effect on water supply and availability. Pavement and other development with extensive impervious surfaces disrupt the natural water balance by increasing runoff and preventing recharge of groundwater. Paved surfaces also increase a community's vulnerability to local flooding and stormwater pollution, particularly in light of the heavier precipitation events and increased storm intensities that the region is already experiencing and is forecast to face more of due to future climate change. The installation of sewers dramatically disrupts the water balance of the Town's waterways and aquifers by taking water from certain sub-basins and discharging it outside the basin from which is was drawn directly into the ocean. Certain types of landscapes require supplemental irrigation which compete for water for essential human uses. Across Ipswich and Parker basin communities, historic and current land use and development patterns are bringing more stress on our local communities' water supply.

After a ten year lull, development is once again increasing rapidly in the region, causing new water demand to increase at the same time as reducing groundwater recharge. With the Safe Yield of the Ipswich River basin exceeded and the sub-basins in the Parker basin where Ipswich draws its water already classified as highly stressed by the State Water Resources Commission, when coupled with the threat of climate change further exacerbating the problem, new development should not be allowed at the expense of our limited and threatened water supplies. Thankfully, there are tools available to communities to guide new development, accommodating growth without increasing overall water demand and disrupting the water balance. Smart growth practices, including "low impact development" strategies and use of "green infrastructure", can be more specifically worked into local regulations to both minimize its impact on the water supply and reduce new water demand.

Low Impact Development (LID) is modeled after nature: it manages rainfall at the source. The goal is to have development mimic a site's natural hydrology (the predevelopment land use) by using design techniques that infiltrate, filter, store, and detain runoff close to its source. Trees and other native vegetation hold soils and help capture and filter water, preserving both water quality and quantity. There are also many other climate resiliency benefits for a community to be gained by more low impact development, including reducing the "urban heat island" effect of downtown or heavily developed areas. Native vegetation does not require irrigation, another benefit in areas where water supplies are reaching their limits. Keeping development away from wetlands and waterways is an essential local action for resiliency.

The Green Infrastructure or LID approach is based on four fundamental principles:

- Treat stormwater as a resource rather than a waste product.
- Preserve, restore, or recreate natural landscape features.
- Minimize the effects of impervious cover.
- Implement stormwater control measures that rely on natural systems to manage runoff.

Green Infrastructure (GI) provides several benefits to help communities better manage water resources, including combatting the cumulative impacts of drought. Precipitation and runoff that is infiltrated into the ground helps to recharge groundwater aquifers and support base flows in stream and rivers. The flow of water below the ground surface is slower and steadier over time than the event-driven flow of runoff via piped drainage systems. GI in the form of preserving undeveloped green space supports drought resilience by preserving the natural infiltration capacity of those open spaces. In addition to drought resilience benefits, GI provides a multitude of other benefits, including:

- Improving water quality
- Providing open space and connectivity
- Reducing heat island effects
- Flood mitigation
- Recharging groundwater for water supplies
- Maintaining stream flow for wildlife and recreation

All municipal boards and committees involved in decisions that affect a community's land use need to be directly involved in "water neutral growth" practices. This includes not just the Planning Board, Zoning Board of Appeals and Building Department whose regulations govern and control development, but also departments and committees that manage Town property (public works, parks and cemeteries, recreation, and schools), that protect water resources, aquatic habitats and public health (Conservation Commission, Board of Health), and that protect and steward open space (Open Space Program). These entities can help promote water supply protection and conservation as well as helping to restore the hydrological balance.

Proper management of stormwater is among the most effective ways to increase the resiliency of local water supplies by replenishing groundwater aquifers. While current local subdivision and wetlands

regulations do a reasonably good job at requiring infiltration and preventing runoff, much land development activity in Ipswich is not subject to these regulations so needs to be captured in other ways. The Town's stormwater bylaw and the new EPA Municipal Separate Small Sewer System (MS4) permit system can be effective tools to capture development that is exempt from Planning Board and Conservation Commission review. The Town should take action to update its bylaw and comply with the new MS4 Permit to capture more of these projects and better ensure that more stormwater runoff is prevented and is adequately infiltrated. Because stormwater regulations only apply to MS4-designated areas, the Town should consider expanding these to the other parts of town to better protect its aquifers and surface waters.

Minimizing the export of water from one watershed to another via wastewater is another effective way to minimize impacts to the natural water supply balance. The Town should effectively eliminate this practice going forward by requiring that any expansion of the Town's sewer system be required to mitigate for its negative impacts on the water balance while seeking to address ways to offset the impact of the existing system. For example, if the Town's wastewater were treated and discharged back into the watershed from which it was drawn, it would effectively address much of the water supply challenges facing the town.

Land use and management is the primary driver of inefficient and discretionary water use in Ipswich and most suburban communities. Caring for residential and commercial landscapes, especially lawns uses a tremendous amount of water, particularly in the summer when water use in Ipswich averages 1.4 times that of winter. Much of this use can be reduced without affecting the quality of our landscapes through simple changes in landscape design and the plants selected. The most effective opportunity to institute these changes is at the time a project is in the planning stages as it is more difficult to make changes once a landscape is installed. One of the biggest threats to local water resources are underground irrigation systems which have proliferated in recent years. These systems use a lot of water and are likely to leak over time, especially as they age and when transferred to a new owner. So called moisture sensing and timer technologies are notoriously unreliable so are not an acceptable hedge against the risk associated with these systems. The threat of these systems to stressed water supplies such as in Ipswich dictate that they simply should not be used.

As described throughout this report, the conditions that the Town of Ipswich is currently experiencing present an opportune time for action. By adopting the recommendations herein, Ipswich can achieve continued growth that does not increase water use above existing levels, resulting in "net zero" water use. Ipswich, along with all cities and towns using Ipswich River and Parker water supplies, can develop and adopt a Water Neutral Growth policy and procedures that sets forth climate-smart best practices to minimize new water demand when approving projects on both public and private water systems.

LAND USE RECOMMENDATIONS

1. Most town boards and committees should become involved in water supply management.
2. Establish a project review mechanism for municipal staff to communicate regularly about projects and activities that impact water supply and land use and to work together to identify strategies for water neutral growth.

3. Adopt a Water Neutral Growth Bylaw that requires developments to offset their projected additional water demand to the extent feasible (Appendix 3).
4. Conduct a thorough audit of Ipswich's local zoning and land use regulations to identify opportunities to achieve the benefits of Green Infrastructure and Low Impact Development utilizing Mass Audubon's Bylaw Review Tool and others located in Appendix 6.
5. Reevaluate the previously created groundwater protection zoning overlay, considering changes to town-wide soil conditions that influence groundwater recharge areas to the public water supply. Enhance development prohibitions that would negatively impact groundwater quantity (and quality). Prioritize the protection of these critical areas through land acquisition and other means.
6. Amend the subdivision bylaw to make Open Space Development and the maximization of LID techniques the de-facto requirement for all new subdivisions and require traditional subdivisions by Special Permit only. Regulations for consideration should include but not be limited to the following provisions:
    - minimize installation of landscape areas requiring supplemental irrigation beyond what rainfall provides;
    - limit land clearing and loss of vegetated cover and preserve natural vegetation;
    - prohibit topsoil stripping and earth removal and require a minimum 6-inch depth of topsoil on all cleared areas to help retain moisture;
    - restrict topographic alterations and require that natural topography be maintained to the maximum extent feasible;
    - preserve or restore a site's natural hydrology (by using techniques such as low-impact development and open-space design);
    - require the use of low water-use/drought-resistant plants, turf, and landscaping techniques, especially drought-tolerant fescues over traditional lawn grasses;
    - encourage or require the use of native, noninvasive plants, appropriate for the site and selected for their ability to adapt to the local climate;
    - prohibit to the extent feasible the installation of sod for lawns as it largely consists of heavy water demand grasses and requires a lot of water to establish and maintain.
    - prohibit the use of underground irrigation systems with possible exceptions for agricultural purposes that connect to the municipal water system.
7. Require that any project requiring a building permit that renovates above a certain threshold (e.g. 25%), expands its footprint, and/or disturbs land be subject to a stormwater and land use review, incorporate LID practices to the extent feasible and upgrades water using fixtures.
8. Amend the Town's stormwater bylaw to make any project subject to a building permit meet the State Stormwater Standards and make it applicable to any project within the watersheds of the Town's water supplies, ensure that the new EPA MS4 Permit conditions are complied with and

make better use of the new Greenscapes Stormwater Collaborative *(with a focus on improving existing conditions).*

9. Seek to minimize the impact of new connections to the Town's sewage system on the water balance by requiring that any system expansion be required to mitigate for its impacts and seek to reduce the impact of the current sewer system by implementing new projects that offset this impact.

2.0 Water Bank/In Lieu Fee: Recommendations for Water Use Mitigation Program

Water Use Mitigation Programs (WUMP's) require that project proponents pay a fee to offset the new water demand that is predicted to be generated by the project and are analogous to the affordable housing in-lieu fee programs currently in place in most communities. These programs can be justified in water-limited communities such as Ipswich under the assumption that the burden of new development should not come at the expense of existing water users or the environment. In recent discussions, the Town of Ipswich Water Subcommittee determined that a closer study of water use mitigation mechanisms that reduce or eliminate the strain of new development on the Ipswich water system was needed. A few other Massachusetts towns (including Ipswich watershed neighbors Danvers and Wenham) currently have a Water Use Mitigation Program, or "WUMP", sometimes known as a Water Bank. Through research conducted during the course of this project, we sought to understand what lessons have been learned by these neighboring communities, as well as from other parts of the country. The study also sought to answer additional questions that were identified by the Town such as: Are there other examples of successful programs in Massachusetts or beyond? How can the Town quantify the benefits that Ipswich could achieve through this tool? This chapter will summarize recommendations of programs appropriate for Ipswich and other local watershed towns.

2.1 Benefits of a "Water Bank", or Water Use Mitigation Program

The new 2018 *Massachusetts Water Conservation Standards* states the following (page 47): **"**In Massachusetts, the term water bank … mean[s] a system of accounting and paying for measures that offset existing water use or mitigate water losses. The primary goals of a water bank are to offset the impacts of new demand to help pay for measures that balance the water budget, reduce water losses, increase water efficiency, reduce discretionary water use and keep water local." Such a program could also help the Town meet the conditions in its current and future WMA withdrawal authorizations, as well as help meet the new minimization and mitigation requirements in the WMA program. Because many communities in stressed basins such as Ipswich need to both minimize demand from new development AND reduce existing use (to stay within regulatory caps, increase system resiliency and lessen impacts on the environment), WUMP's often strive to offset existing water use in ratios greater than new demand (e.g. two gallons saved for each gallon of new use).

The 2018 Water Conservation Standards continue:

> "Water banking can be an effective management tool for "water-short" communities where development pressure is exceeding the carrying capacity of water resources. It is also a good option for communities concerned about their ability to meet projected water demand and to

protect the environment. A water-banking program can free up water and ensure that there is an adequate supply of water for competing uses – i.e., instream flow and habitat, recreation, wetlands, water supply, and economic development. It can mitigate, or offset, the impacts of water withdrawals, balance the water budget, assist in restoring and protecting instream flow, promote water conservation, and ensure an adequate supply of potable water. Massachusetts' communities are beginning to use this tool to accommodate future growth while ensuring the sustainability of their water resources."

Working with the Ipswich River Watershed Association, the Town developed a standard set of questions to establish a baseline for this research and review of Water Bank programs. These questions were:

1. *When and why did the program start?*
2. *What are the basic components and operation?*
3. *Besides the Water Department, what departments have a role in the program? Does the Planning Department, Zoning Board? If yes, in what ways do they participate?*
4. *What water savings do they see? (Does the program actually save water or is it more of an alternate revenue stream for project funding). If they can't quantify, what would it take to find out?*
5. *Are there specific criteria for how the money can be spent? Who oversees/audits that and how are the savings quantified? (Per project?)*
6. *How is the program working now? Has it been more difficult to find water savings as time has gone on? Might this become a problem in the future?*

Several areas of research were conducted in the course of this project to better understand and analyze the establishment of a Water Use Mitigation Program for the Town of Ipswich.

2.2 Research and Review of the Local and National WUMPs

Two Ipswich watershed neighbors, Danvers and Wenham currently have a Water Use Mitigation Program. Research on these programs included:

- In-person discussion between Ipswich Water Department staff and Danvers municipal staff
- In-person discussion between Wenham municipal staff and Ipswich River Watershed staff
- Review of annual reports submitted by the Town of Danvers to the Massachusetts Department of Environmental Protection summarizing WUMP results

A thorough review of other WUMP's and related programs nationally (with a focus on Northeastern states) was conducted and the most applicable of these summarized in Appendix 7. Based on this research, we did not find substantive information to inform the development of a WUMP in Ipswich beyond what was learned from the local Danvers and Wenham models and reflected in the draft WUMP created by the Ipswich Water Department. This said, we did conclude that there are several critical components of successful programs:

- Identifying and maintaining a *current prioritized* list of WUMP-eligible projects that can be used by the community, developers and project partners to offset water use.
- Adequately investing in the resources necessary to manage the program on an ongoing basis.
- Selecting an offset fee sufficiently high enough to generate adequate revenue to make meaningful investments in water savings projects.
- Finding an appropriate balance between the requirements of project proponents and the water use bylaw.
- Require that commercial and agricultural water use be included.
- Require that all projects that potentially impact the Town's water sources and aquifers be included so as not to incentivize the installation of private wells to avoid the regulations.

As part of this project, the Town Planning Department conducted an initial assessment of the projects that came before the Planning Board and Zoning Board of Appeals that would be subject to such a bylaw and calculated the amount of revenue that would have been generated over that period. We also made a cursory effort to calculate the amount of water that could theoretically be saved in the community if the resources generated by the WUMP were deployed *and* those resources were deployed to implement and support a comprehensive water protection and savings program in the community that included the implementation of the recommendations in this report. The results of these analyses are summarized as follows:

- Over the last five years, an estimated $80,000 in revenue would have been generated through an assessment on residential development projects subject to Planning Board review alone.
- Revenue potential is considerably higher were other types of projects to be included in the assessment (e.g. water-using projects subject to building permits, commercial use, etc.) or if the fee levels were higher. These additional revenues could be roughly comparable to those generated by residential development.
- Although it is extremely difficult to estimate the amount of water that could be saved under such a program due to the number of variables, significnat savings may be possible, much of this being captured during the most critical summer months.
- Should these levels of savings be achieved, Ipswich could rely on its current water supplies for the short and medium term while increasing system resiliency and reducing its impact on the environment.

As these results demonstrate, there are many considerations that need to be taken into account. First, the proper interplay between the Water Use Bylaw being recommended and the WUMP is critical since it is theoretically possible to require that new development minimize its water use to such an extent that relatively little fees would be generated. Second, given the major costs associated with water-related infrastructure, the potential fees that could be generated by a WUMP in Ipswich likely on the order of $25-30,000 per year are unlikely to provide sufficient funds to address capital projects which are very costly. This said, revenue on this order of magnitude could support such activities as hiring an in-house, part time program manager (or contract for these services through an expanded Greenscapes program for example), support rebate programs, provide local match for grant programs, etc. [Since the

vast majority of meaningful water savings identified in this report involve modifications to current municipal procedures and changes in residential and business practices which are relatively low cost to implement, these fees could theoretically support such a program]. Third, the law of diminishing returns applies to water saving programs as the highest cost/benefit projects in the community are addressed earlier such that it will become more difficult to identify savings over time. Fourth, it may simply be easier to raise water rates to accommodate new costs of a comprehensive water saving program than the administrative burden of administering a WUMP. This said, why should the impacts of new development and discretionary water use by some residents come at the expense of existing water users and the environment? In this sense, a well implemented WUMP could be an integral part of a comprehensive water savings program in Ipswich.

2.3 Regional Strategies for Water Use Mitigation

As mentioned previously in this report, the Ipswich and Parker River watersheds are under increasing stress. New regulations governing water withdrawals in Massachusetts under The Water Management Act promulgated in 2014 are placing increasingly challenging restrictions on local water suppliers. Most importantly, the regulations established the safe yield for the Ipswich River Basin below existing water withdrawals which means that municipalities will need to stay within or below existing withdrawals in perpetuity and require that any new withdrawals from the Parker will need to be mitigated to completely offset the environmental impact of those withdrawals. Thus, it is critical that communities dependent on these rivers reduce existing water consumption, minimize and offset additional demand created by future growth and development. As has been successfully demonstrated in Danvers and Wenham, local communities can take on the burden of establishing and administering a WUMP on their own. However, as has been experienced by Danvers, administering such a program can be onerous and as water saving projects are implemented, it can become more difficult over time as the projects with the highest cost-benefit get implemented first. Because of this, coupled with the fact that more local towns could benefit from a WUMP, the Town should help to catalyze discussions around the exploration of creating a regional WUMP. The Greenscapes North Shore Coalition could be a good vehicle to advance this exploration.

RECOMMENDATIONS FOR WATER USE MITIGATION:

1. Adopt a Water Use Mitigation Program (WUMP draft, Appendix 8) in concert with the Water Use Mitigation Bylaw (Appendix 3). Program should strive to achieve at least a 2:1-gallon offset ratio (offset 2 gal. of existing use for every 1 gal. of new use proposed).
2. Develop and maintain a prioritized list of WUMP-eligible projects and activities that can qualify for WUMP funds, such that developers can offset their projected use under the water use bylaw and that can be used to pursue grant funding to help implement water use reduction projects.
3. Help to catalyze a discussion with local towns and partners on the creation of a regional WUMP.

3.0 WATER CONSERVATION: RECOMMENDATIONS FOR ENHANCED WATER CONSERVATION STRATEGIES

Water is a limited resource and our water supply is threatened by population/economic growth, climate change and the need to minimize environmental impacts. We know that most people take some actions

to save and conserve water, but we also know that there is a lot more that can be done as Massachusetts' water usage is still relatively high as compared to other advanced societies around the world. Water conservation and efficiency needs to become the norm across all activities throughout everybody's lives—wasting water should be seen as going against the norm. In order to achieve this, water efficiency activities must be scaled-up across the board, by all parties.

Conserving water is the most direct and lowest cost way to ensure its availability in the future—what some might say is the "low hanging fruit." While steps have been taken and some gains have been made toward reducing water use across the Ipswich and Parker Watersheds in recent years, there is more that can be done, especially in the summer when water use is the highest, there is the least amount of water available, and the threat of drought is highest. For example, during the summer, Ipswich's water use (similar to that of most communities) increases significantly, which indicates a high amount of discretionary water use.

This study conducted the following activities to inform the development of its water conservation recommendations:

- A thorough investigation of the town's current water conservation and water loss programs;
- A thorough analysis of state-of-the-art water conservation practices including the recommendations of the recently completed *Massachusetts Water Conservation Standards*
- A review of the results of the Massachusetts Department of Environmental Protection and Division of Ecological Restoration's community-based social marketing project (2017-2019) that was conducted locally and in other parts of the State
- A detailed evaluation of Ipswich water use data and individual water use patterns was completed to develop a water use profile and inform recommendations.

3.1 Assessment of the Town's Current Water Conservation and Drought Management Practices

As previously stated, the Town of Ipswich has a relatively robust water conservation program. Since the 1990's the Town has instituted seasonal water restrictions during dry periods based on precipitation and reservoir levels. In 2002, the town developed a Drought Management Plan (DMP) which calls for increasing levels of water restrictions based on current drought status which is posted publicly:

Figure 4: Ipswich's Water Restriction Advisory as Posted on 12/27/19

The plan was recently updated in part due to the 2016 drought emergency declaration and is currently in the DEP review process. These programs helped achieve the significant water reductions seen since

the Town's peak water usage in the late 1990's. These restrictions/bans apply to not only those who use public water, but to those with private wells as well since they often draw from the same aquifers. Driven in part by exceedances of its State withdrawal permit in the mid to late 90's, the Town instituted a seasonal rate structure for residential customers of 1.5 times the base rate (and 3x the winter rate) designed to incentivize reductions in summertime discretionary use. In 2006, the Water Department conducted a comprehensive water audit of its entire system designed to identify inefficiencies, water loss (e.g. leaks) to minimize the discrepancy between what the Town pumps from its sources and ultimately received by its customers as represented by their water bills. For many years, the Town has conducted an aggressive leak detection survey which covered the entirety of the distribution system annually. Each year, sufficient funds are budgeted to promptly repair any large leaks found. Unlike many communities that bill their customers for water four times a year, Ipswich bills on a monthly basis and provides usage graphs on bills which provides its customers a much more frequent and timely indication of their water use which can lead to quicker identification of any leaks and changes in discretionary water use. Timely customer use data coupled with the seasonal rate structure can be particularly powerful tools to reduce discretionary water use. Most recently, the Town completed replacement of all its customer water meters with smart meters which provide data to the water department for fast and easy detection of problems. With 100% of the Town now on smart meters, the Town is aggressively moving to take further advantage of the many additional features provided by the technology to inform and engage customers on water use related activities and behaviors.

Beginning in the early 2000's, the Town implemented a more comprehensive public education program on water conservation. The Town is a member of the Greenscapes North Shore Coalition which is a collaboration of area municipalities designed to provide the public with educational materials and programs on water conservation and environmentally friendly land care. In partnership with EPA's Water Sense Program, the Town offers rebates for the upgrade of inefficient water appliances and provides educational materials in customer water bills. The Town partners with a local nursery to provide rain barrels to its customers at a steep discount. More recently, the Town Water Director joined the regional Parker-Ipswich-Essex Rivers Restoration Partnership's water conservation working group which created a multi-year implementation plan as part of its Action Plan to increase water conservation throughout these watersheds.

These programs were successful at significantly reducing water use in Ipswich by about 20% between the peak usage of ~430 million gallons per year in the mid to late 90's and a recent low of ~340 million gallons in 2014. While these efforts were and are successful at lowering water use, this study focused on identifying additional opportunities to further reduce use often referred to as *enhanced water conservation practices*.

3.2 Water Use Profile Analysis

An essential component of a project such as this is to analyze and understand current water use in the community in as much detail as possible in order to identify targeted opportunities for enhanced water savings to inform specific recommendations. To this end, staff at the MA Division of Ecological Restoration (DER) worked with the Town of Ipswich Water Department to complete a thorough analysis of the Town's water use data. Since use data can vary significantly from year to year based on climate conditions and one-time events (e.g. drought, major water main break), the years of 2017 and 2018 were used which were deemed to be representative of typical water use in the community. The results of the analysis are in Appendix 9. The analysis indicates that there is considerable room for discretionary

water use reductions centered primarily on a highly targeted approach with a relatively small percentage of overall water users in both the residential and commercial sectors. Highlights of the analysis include:

- Single family residences use about 60% of the water used in the town. Commercial entities use roughly 30% and multi-family and municipal departments use approximately 10%.
- Single family residential use increases by about 25% in the summer. The top 10% of residences were responsible for 60% of the summertime increase residential water use, primarily due to discretionary lawn watering.
- Commercial use increases by about 30% in the summer. Virtually all that increase is by only 27 customers of which 7 are responsible for more than half. The increase in summer use by the sector is due to a combination of non-discretionary (essential part of their business) and discretionary.
- Use by multi-family and municipal accounts is relatively consistent throughout the year.
- Only 2-3.5% of the Town's water use is due to seasonal accounts which indicate that the vast majority of the seasonal increase in water use is due to discretionary use.
- About 16% of the Town's water use is lost before it reaches customer meters (unaccounted for water or UAW). This percentage began to rise above 10% in 2014. The Town is committed to enhancing efforts to reduce UAW.

3.3 Water Conservation and Use Reduction Best Practices and Opportunities

Following this review and discussions with the Town of Ipswich Water Department, the Ipswich Water Subcommittee, state agency water management experts and other community and regional partners, the following topical areas were examined for opportunities to achieve increased water conservation results for the Town. These areas are organized in the following categories so as to align with the *Massachusetts Water Conservation Standards* which were updated in 2018:

1. Comprehensive Planning and Drought Management Planning
2. Water Loss Control
3. Metering
4. Pricing
5. Residential Water Use
6. Public Sector Water Use
7. Industrial, Commercial, and Institutional Water Use
8. Agricultural Water Use
9. Outdoor Water Use

1. COMPREHENSIVE PLANNING AND DROUGHT MANAGEMENT PLANNING

Establishing long-term priorities and plans for water resources management is critical to addressing future needs. Historically, water resources management in Ipswich has been done somewhat independently by the responsible party; the Water Division regarding drinking water, The Wastewater Division Regarding the sewer system, the Health Department for private wells and septic systems, the

Conservation Commission regarding wetlands and waterways, the Department of Public Works for stormwater and the Planning and Zoning Boards regarding land use. Ideally, water resources would be managed via a "One Water" approach, managing water supply, wastewater, and stormwater in an integrated way within a given watershed to make the water systems upon which the Town depends more resilient, especially in light of climate change and a more constrained future.

In terms of water conservation, the Town's Drought Management Plan and Water Use Bylaw are the primary planning documents that contain these measures. They are organized by practices that are implemented on an ongoing basis (e.g. seasonal rate structure, education programming) to minimize inefficient and discretionary water use in general and those that are implemented on an as needed basis due to various conditions or triggers (e.g. water restrictions, emergency declarations). Ideally, all potable water would be used as efficiently as possible at all times and there wouldn't be a need for trigger-based actions. However, there are multiple factors at play making implementation of such a system difficult, especially at times of high-water availability. One way to make the water supply more resilient is to save more water sooner to protect against future drought and periods of predictable higher seasonal demand. Ipswich's current system on what triggers water restriction measures relies on a relatively sophisticated system based on reservoir levels and local precipitation amounts. While this system has served the Town for some time, it may not be predictive enough in times of increasing dryness when water use is high. For example, during the drought of 2016, restrictions were not triggered until after the drought was in full force when it could have saved more water sooner. In the summer of 2019, Ipswich was the only local town (of those that include water restrictions as part of a drought management plan) that did not impose watering restrictions, despite a relatively long dry spell and stream flows in both the Parker and Ipswich Basins well below ecological thresholds. For these reasons, the Town has since updated its Drought Management Plan to include additional metrics to determine drought stages. The Drought Management Plan should be sensitive to the relative use between surface and groundwater sources and consider the impact of withdrawals on the environment.

2. WATER LOSS CONTROL

According to the *2018 MA Water Conservation Standards* (page 10), "Water loss control is the implementation of best management practices to ensure that water entering a distribution system is efficiently delivered to each point of use. Water loss control measures typically entail accounting for the water distributed in the system and managing the infrastructure to prevent system losses. Evaluating the measures for their effectiveness is also a part of water loss control."

The EPA industry standard and the MA Water Conservation Standard for "Unaccounted for Water" (UAW) is 10%. UAW can come as a result of "apparent" losses which may or may not be actual and "real" losses which are typically leaks. The Ipswich 2018 Annual Water Use Report stated that the Town had a total of 60.4 million gallons per year (MGY) UAW, or 15.9% of their total water use. Unlike many towns that cannot easily determine the source(s) of their UAW, Ipswich estimates that 40 MGY of these 60 MGY were real losses to leaks in 2018. The Town currently works with a vendor to complete annual audits, which has resulted in regular leak detection and repair. Despite these ongoing efforts, the Town's UAW, which was as low as 6% in 2012, has been rising in recent years, as shown below.

Ipswich Unaccounted for Water		
Year	**MGY**	**% UAW**
2012	23.1	6.8%
2013	18.6	5.5%
2014	35.0	10.1%
2015	39.1	10.8%
2016	48.7	13.6%
2017	59.1	15.8%
2018	60.4	15.9%

As was previously noted, in 2006 the Town conducted an extensive audit of its distribution system to investigate the sources of its UAW. In 2006-2007, Ipswich completed a Water Loss Control review of the entire water system, funded by MA DEP's Water Loss Prevention Grant Project. However, it is evident that in order to address the Town's rising UAW, further steps are needed and if successful, could save a lot of water. A new Audit Tool known as M-36 is thought to provide a more rigorous analysis than what has been available historically and can be paid for through the same DEP Grant Program.

3. METERING

With 100% of the community now on SMART meters, Ipswich is in the process of upgrading its systems and procedures to take full advantage of this technology to reduce water use. These meters provide for continuous readings and software can be used to automate leak detection notification, identify and notify unusual water use patterns and provide instantaneous and detailed customer feedback on water use that can help modify behavior. In concert with smart metering and monthly billing, Ipswich has an ideal system to utilize normative billing practices to provide custom materials on or with bills to influence water use. For example, comparing your water use against established or comparative norms can be very effective according to the emerging science of community-based social marketing.

4. PRICING

Pricing can be one of the most effective ways to drive water use reduction, particularly with regards to discretionary uses which have been shown to be most responsive to price signals (MA Water Conservation Standards, 2018). Ipswich has firsthand experience of this phenomenon with its highly successful seasonal rate structure for residential use. This said, an examination of the water use profile for the community shows that many large residential water users do not seem to be affected by the seasonal rates, nor are certain commercial users since they can easily afford their water bills or are paid by a third party so those responsible for water use decisions are insulated from the price signal. Moreover, the Town currently exempts commercial customers from the seasonal rate structure due to the negligible seasonal use increase of the class during the analysis period (1999-2001). Analysis conducted in 2017 has shown a growing seasonal increase by commercial users thought to be required as a core part of their businesses. The 2019 analysis clearly demonstrates that a certain percentage of commercial customers use discretionary water. Even if water is critical to the core function of a business, pricing could still be used to encourage more efficient use of water. For example, one of the largest commercial customers in Ipswich uses town water for industrial process cooling purposes. If a

closed system were installed to replace its current flow through system, a tremendous amount of water could be saved by one of its largest water users.

State law prohibits decreasing block rates to discourage high water use and requires that water bills reflect the full cost of providing water. Ipswich could investigate various rate structures to further discourage high water use and incentivize more efficient use. Ipswich could also ensure that additional costs associated with the water system not typically included in the rates are included, such as the costs of implementing an enhanced water conservation program or mitigating impacts on the environment. It is important to note that if the cost of water (and/or other conservation efforts) leads to a significant reduction in use, Water Department revenue will decline, requiring implementation of further pricing strategies to support the operation. Another major consideration of increased pricing is not to incentivize the installation of private wells which in many instances competes for the same sources as the public water supply. Since the year 2000, more than 2000 private wells have been installed on properties served by public water in the Ipswich River Watershed in communities following the implementation of increased restrictions on municipal water supply (Ipswich River Watershed Private Well Study 2019). To help prevent these secondary impacts, the Town should continue to make private well restrictions the same as those on the public system and consider prohibiting new wells in aquifer areas that contribute to the public water supply.

5. RESIDENTIAL WATER USE

Approximately 60% of the water used in Ipswich is by residences, mostly single family houses. Residential water use consists of both indoor and outdoor uses. In recent years, indoor water use has become more and more efficient largely driven by mandatory state and federal plumbing codes that require water using fixtures to meet minimum efficiency standards. Thus, the most fruitful areas to achieve additional efficiencies regarding indoor use involve the upgrade of existing older water using fixtures to more efficient versions and changing individual behavior to use less water indoors. Because the only time that existing fixtures are generally replaced is when they fail or during renovations and that replacement fixtures on the market today are already sufficiently efficient, offering traditional rebate incentive programs to replace old fixtures probably have a relatively low cost benefit in Ipswich since they will largely happen on their own over time anyway. Hence, most opportunities to reduce indoor use should focus on continued and expanded educational programs to promote water-using behavioral changes indoors.

One residential use area that is extremely difficult to evaluate is the amount of leakage on private property between the service connection and the water meters which are usually located inside the buildings. Given the age of service connections, the relatively long distances between the street and the buildings in some areas and the existence of many large estates/institutions in town, it is possible that a percentage of the Town's UAW and overall water use could be due to leaks on private property. Annual leak detection surveys do attempt to capture this loss and meter pits near the property line are required on services in excess of 200-feet. However, it is not known how many services do not comply with this requirement. While the water use analysis cannot tease out this potential area of water loss since it wouldn't necessarily have a seasonal signature, a next level of analyses looking at the individual records and properties associated with the top 10% of water users could identify households that are good candidates for further investigation.

Regarding outdoor water use, most use in Ipswich can be considered discretionary such as lawn watering, car washing, power washing and pool filling. Outdoor water use remains relatively high overall but that use is concentrated amongst a relatively small number of water users making targeted and customized efforts critical to reaching this audience. Since the Town and society as a whole has been attempting to reduce discretionary use for some time through various outreach and educational programs, this particular audience seems relatively immune for these traditional methods dictating that more effective methods be used. The proliferation of automatic underground irrigation systems in Ipswich is a likely component of this phenomenon as it is in many area towns (Ipswich River Watershed Association). Because outdoor residential use is such a large component of water use in Ipswich, a separate section is dedicated to this topic below.

The *MA Water Conservation Standards* sets a minimum efficiency measure for residential water use at 65 residential gallons per capita per day (RGPCD) or less. This RGPCD varies tremendously between communities and is subject to many variables. Typically, cities and communities with dense development and multifamily homes use much less water and towns and suburban communities with large landscaped lots use more. As shown in the table below, Ipswich residential water use varied between 46-50 RGPCD which is mid-range between the two community types but below average when compared to other comparable suburban communities (Ipswich River Watershed Association):

Ipswich Residential Water Use (Gallons per capita per day)	
Year	**RGPCD**
2012	**48**
2013	**49**
2014	**50**
2015	**50**
2016	**46**
2017	**46**
2018	**46**

Although RGPCD is a relatively crude measure of a community's water efficiency, Ipswich should strive to make continual improvements in this figure. If the opportunities identified in this report were to be implemented, Ipswich could be reasonably expected to settle in the low 40's which would save millions of gallons of water per year.

6. PUBLIC SECTOR WATER USE

Water use by the municipal sector in Ipswich is relatively low and constitutes about 5% of overall water use. This use consists mostly of water used in town buildings: schools, public safety buildings, Town Hall, public housing and the various departmental satellite facilities located around town such as the DPW garage, utilities campus, cemeteries and parks, etc. The analysis revealed that the use is more or less

consistent year round which indicates that there probably isn't a lot of discretionary use associated with the public sector overall, although there is some indication that summer use does increase somewhat since use does not appear to go down when schools are out of session. A cursory examination of municipal buildings and land use indicates there is some but not a lot of opportunity to reduce water use as compared to other sectors in town. Several of the buildings are relatively new (High and Middle School) or have been recently renovated (Town Hall). This said, there are many older town facilities still in active use. Individual municipal building audits and staff education are two effective ways to reduce water use in public facilities. Because making improvement to town buildings are one of the easiest and most efficient ways to deploy water use mitigation funds, identifying potential water saving projects in town buildings should be prioritized. Water use in municipal buildings should be at the forefront of any water use efficiency effort and help serve as demonstration projects for the general public.

Ipswich is currently engaged in a number of building projects that could come to fruition in the coming years, including one or two new elementary school(s) and a new Public Safety Complex (Police and Fire). As plans are finalized for these projects, it is imperative that the buildings are developed with net zero water use, incorporating water efficient fixtures as well as waterwise landscaping into the final designs, installation, and maintenance. Architects considered for work on any capital project involving the Town should be selected in part based on their demonstrated familiarity with water conservation efforts when citing their qualifications, as should construction contractors.

7. INDUSTRIAL, COMMERCIAL, AND INSTITUTIONAL WATER USE

While a majority of attention has historically been placed on residential water use, as it is the largest customer class and has a large seasonal increase, the water use analysis clearly indicates there are significant opportunities to reduce water use in the commercial, industrial and institutional sector (hereafter referred to as commercial). The commercial sector represents about 30% of total water use, but uses roughly 40% of that water in the summer which is a significant percentage of the seasonal increase seen in Ipswich. Of the water used in the summer, some is required for the core function of the business, as many businesses in Ipswich have a strong seasonal component, but some use is clearly discretionary. A surprisingly high percentage of water used in town, particularly in the summer, is by a very small number of commercial accounts. Of the Town's 348 commercial accounts, fewer than 30 account for the majority of commercial water use while only 7 account for more than half of the summer increase seen in the sector. Based on publicly available and anecdotal information about these businesses, the use profile indicates that working with this small handful of businesses directly could generate a lot of water savings.

Like residential use, water use in the commercial sector consists of both indoor and outdoor uses so the strategies that need to be deployed will vary accordingly and can be informed by water saving recommendations for other sectors in this report. Given that so few businesses are responsible for so much water use, it should be possible to customize those strategies based on the individual entities and their specific water use profile. A somewhat unique aspect of the commercial sector in Ipswich is that several of the largest water users own relatively large campuses with multiple buildings with extensive, older water distribution systems which may be particularly subject to water losses and/or inefficient water use. Another relevant aspect of the commercial sector is that property managers are less likely to be responsible for paying the water bills. Since water is often simply seen as a cost of doing business,

commercial water use may be relatively immune from a price signal which is typically an effective water conservation tool. In many instances, commercial users are particularly amenable to saving water if the decision makers became more aware of the problem and were provided the proper tools to address their specific issues since many are conservation oriented. An assumption is often made that the commercial sector needs to maintain current levels of water use as a core part doing business. However, like electricity, water can almost always be used more efficiently and oftentimes significant savings can be achieved if motivation is strong and can be incentivized. These factors indicate that an aggressive water conservation program targeted at these customers could generate the most water savings with the least amount of effort in Ipswich. Initially, work should focus on the businesses served by the municipal sewer system or are located along the coastal area outside of the zones of contribution to the public water supply as commercial customers that rely on septic systems in water supply watershed areas are less impactful since they return most of the water used to the aquifer.

8. AGRICULTURAL AND RECREATIONAL WATER USE

Ipswich has approximately 40 agricultural operations (Ipswich Agriculture Study 2012), including plant nurseries, and by their very nature use a lot of water as a core function of their business. Because of their relatively high water use and difficulty of passing along costs to their customers, most agricultural entities in Ipswich rely on private wells or surface water withdrawals to meet their water needs, which are exempt from the Town's private well bylaw, making it more challenging for the Town to influence their water usage. Moreover, a portion of agricultural entities in Ipswich are required to use highly inefficient means of watering due to the requirements of the commodities they produce (e.g. overhead irrigation of sweet corn and nursery crops, large livestock watering systems) making it extremely difficult to achieve water savings without threatening their business. To put this water use in perspective, one farming operation in Ipswich can use half as much water as the entire town on a hot summer day (Ipswich River Watershed Association private well study 2016). Ipswich has two large golf courses which are often heavy users of water to maintain their turf. In both cases, they rely on private wells to provide for their irrigation needs, one of which is in the zone of contribution to the Town's water supply aquifer. The Town's Cemeteries and Parks Department and Public Schools manage several municipal athletic fields that rely on irrigation water, supplied by both the public water system and private wells.

Despite the unique challenges regarding water use by agricultural and recreational entities, there are some opportunities to reduce water use in this sector. First, many of these operations do utilize town water as part of their businesses and many withdraw water from the Town's water supply aquifers and tributaries making any savings worth pursuing. Second, agriculture can benefit from a myriad of state and federal programs that consult on and subsidize and/or pay for the cost of implementing water conservation measures. Third, the Town has good connections to many of these entities and activities in the form of its Agricultural Commission and municipal staff-managed athletic fields, so pursuing water savings amongst these entities should be worthwhile despite its unique challenges. The Town should approach this sector in similar ways to commercial use above, by focusing on the highest water users with the most impact to the water supply either directly through public water use or indirectly through private withdrawals from the public water supply aquifer and its tributaries.

9. OUTDOOR WATER USE

In most years, New England receives enough rain to maintain a healthy summer lawn, yet large amounts of water are still used for lawn irrigation. A typical Massachusetts household that regularly waters their lawns in the summer uses 1900 gallons a week—equivalent to running your shower for 12 hours (MA

Water Conservation Standards, 2018). Unlike indoor use, lawn watering is an entirely consumptive use as virtually all water used for lawn irrigation is lost due to evapotranspiration or runoff. In many suburban towns, water consumption nearly doubles from winter to summer, putting a strain on community water resources. Due to several successful initiatives, the average Ipswich winter to summer ratio is 1.26. Although the Ipswich ratio is not as high as other communities, efforts should continue to diminish the summer use. Reducing or eliminating lawn watering will save water, money and time, as well as contributing to water supply resiliency. As such, reducing this one source of water use is the single most important way for communities to save the most water since it is completely discretionary. As the Commonwealth of Massachusetts' Water Policy states: *"Maintaining lawns and landscapes should not come at the expense of public health and safety or the environment."*

Yet despite this generally understood knowledge and the fact that lawns do not need supplemental irrigation to remain healthy in New England (Greenscapes.org), changing lawn watering behavior has been a particularly intractable form of water use. Although some people cannot be influenced to change their behavior, research in the Ipswich River Watershed has shown that many people feel that their lawn will die or be harmed if it is not watered and/or that lawn watering does not use that much water (MA Water Conservation Pilot). This research has shown that these concerns can be addressed utilizing the emerging fields of community-based social marketing as a way to change lawn watering behavior. As was noted in the residential use section, the water use analysis indicates that residential water use increases by about 25% in the summer, most likely due to lawn watering. Moreover, 60% of that increase is from only 10% of residential customers indicating that relatively few customers are responsible for the bulk of discretionary use. As such, a targeted approach to these high-water users would be most effective way to reduce water use amongst this sector.

Because lawn watering is the largest form of discretionary water use in Massachusetts, particularly in suburban communities with stressed water supplies like in Ipswich, water resource managers at State Agencies, regional watershed advocates and local communities have been seeking alternative ways to address this problem for many years. Recently, these groups initiated a series of pilot projects in Ipswich Watershed towns of Wenham and Middleton which has since been expanded to other communities around the state. This multi-year effort resulted in the publication of the *Healthy Lawn, Happy Summer Toolkit* which provides tools to help municipalities and other entities to reduce lawn watering. The project demonstrated that if implemented, savings averaged 39 gallons per day overall (with one town averaging 128 gallons per day savings) per household. If such a program were successfully implemented in Ipswich, significant water savings can be expected.

While lawn watering is by far the largest source of water use, there are many other discretionary uses of outdoor water use including power washing, pool filling, car washing and ornamental plant watering. Efforts should be made at reducing these uses and many tools exist that target these kinds of uses that should be deployed in Ipswich. Unfortunately, outdoor water use is particularly hard to address since it involves largely behavioral and cultural factors. As such, educational and engagement efforts need also to be coupled with effective enforcement programs to succeed and be maintained over time. Water use data and anecdotal observations conducted by municipal and Ipswich Watershed staff during the drought of 2016 showed a significant amount of outdoor water use in violation of the Town's water

restrictions, particularly during the early stages of the drought before it became an emergency. As a result, Ipswich recently passed an amended Water Use Bylaw in 2017 which clarified the Town's enforcement role which should help in future compliance with the Town's outdoor water use regulations.

RECOMMENDATIONS FOR WATER CONSERVATION AND USE REDUCTION STRATEGIES:

The following recommendations assume the Town's existing water conservation programs are maintained and any additional costs to implement these programs will be provided by the WUMP, the pursuit of new funding and through expansion of existing collaborations and partnerships described in section 4.

1. Expand the Town's existing water conservation program so that it effectively implements all relevant water conservation standards and recommendations in the new 2018 Massachusetts Water Conservation Standards.
2. Execute the Town's recently updated Drought Management Plan, once approved by MassDEP. Updates include consideration of local stream flow trigger(s) so that water restrictions begin sooner and provide for more drought resiliency.
3. Prioritize the reduction of the Town's Unaccounted for Water Use (UAW) to 10%, with a long-term goal of achieving 6% or less. The Town should partner with the State to conduct an American Water Works Association M36 Audit to inform a UAW reduction plan, expand its current leak detection program using advanced and automated technologies, and increase resources available to make small leak repairs which can be delayed at the expense of larger ones. Because of the benefit to the municipal system, the public leak detection program should include and prioritize service connections on private property.
4. Implement the plan to fully utilize all water-reduction tools that the new Smart Meter system makes available.
5. Maintain the seasonal water pricing structure and investigate other rate structures that would incentivize a reduction in discretionary water use. The public should be intimately engaged in any water rate setting.
6. Continue to prioritize the water main replacement program to include the mains that use water bleeders to maintain water quality. Eliminate the use of water bleeders as soon as possible.
7. Further subsidize existing water conservation incentive programs (such as the rain barrel subsidy), pay for residential water audits for the top 25% of customers, and offer generous rebates for fixture upgrades that were specifically identified during the audits.
8. Monitor the Town's Residential Gallons used Per Capita Per Day (RGPCD) to ensure that it is on a steadily declining trajectory until it reaches and sustains a level of 42 or less.
9. Conduct a water audit of all municipal and school buildings and outdoor use, implement measures to maximize the efficient use of water, educate municipal staff on water conservation practices, and prominently interpret water-saving projects and activities to the public.
10. Conduct an individual water use profile analysis of the top 37 commercial users and develop a customized water use reduction program for each. Make water audits available to all commercial customers, with a particular focus on the top 7 users. Engage

senior management directly to solicit agreements to pursue aggressive use reduction goals.

11. In addition to including agricultural use in the measures called for in recommendation 10 above, engage with the State Department of Agriculture and the US Natural Resources Conservation Service to work directly with individual businesses to recommend and fund implementation of water conservation measures.
12. Implement the new *Massachusetts Healthy Lawn, Happy Summer Toolkit* amongst all its residential customers that show significant discretionary water use according to the water use profile. In addition, engage the top 5% of residential customers individually to pursue specific water use reduction goals.
13. Offer a generous rebate program for the decommissioning of existing underground irrigation systems.
14. Increase its capacity to enforce its water savings activities and regulations.
15. The Board of Health should adopt more stringent permitting requirements on the installation of private wells, ensuring adequate water conservation practices. Prohibit new wells in zones of contribution to the Town's water supply watersheds and in stressed sub-basins as designated by the State Water Resources Commission.

4.0 New Systems and Procedures: Recommendations for New Programs, Collaborations and Capacity for Water Neutral Growth

Historically, virtually all water-supply related issues have been the responsibility of the Water Department and the Water Subcommittee of the Select Board (Water Commissioners). The primary responsibility of the Water Department is to provide the community with reliable and safe drinking water to meet the water supply needs of the community and for fire protection. While this department must necessarily play an integral role in many of the measures recommended herein, its primary role in the community cannot be diluted to take on this added burden. As highlighted in this report, addressing the water supply constraints facing the community including its water neutral growth aspirations is multi-faceted and will require the intimate involvement of many municipal Departments and Committees, as well as an engaged and participatory citizenry. This will require not only additional capacity but a new paradigm on how the community as a whole manages and views its relationship with water.

Given the need to create a new paradigm and the effort that will be required, this effort could benefit from the creation of an ad-hoc working group of relevant municipal stakeholders, topic area experts and interested public. To be successful, these efforts need to be captured in an implementation plan and ideally be backed up by a comprehensive water resources management plan which integrates all aspects of water resources management in the community. While many of these measures will require additional funds and increased municipal capacity, the Town should better leverage the myriad of opportunities for partnerships and collaborations that exist to assist in these efforts as described below.

4.1 Public Education and Outreach

While many of the measures recommended in this report will require the intimate involvement of municipal staff, boards and committees as well as new regulations and associated enforcement programs, they will have limited impact if not also accompanied with buy in from the Town's citizenry

and businesses. All residents, institutions and businesses need to understand the challenge, recognize their role in addressing it and participate in solutions. While participation will certainly vary, more emphasis needs to be placed on effective education and outreach to achieve the level of engagement that will be needed to achieve water-neutral growth and the water use reductions called for in this report.

While the Town's existing water conservation education program needs to be expanded, the Town should look to its existing education and outreach service provider, the Greenscapes North Shore Coalition to help advance this effort. Currently, Greenscapes provides its basic level of services as part of the Town's current subscription. The Town could ask Greenspaces for its "enhanced" program as well as explore opportunities to take on customized programming on behalf of the Town to advance specific recommendations in this report. In addition to Greenscapes, the Massachusetts Water Works Association and other water supply industry groups, of which Ipswich is a member, offer educational programming and materials, as well as technical assistance on developing and delivering effective programs that could aid in this endeavor.

RECOMMENDATIONS FOR NEW PROGRAMS AND CAPACITY:

1. Form an interdisciplinary ad hoc committee to create a Water Supply Resiliency Action Plan to implement these recommendations.
2. Hire a part time staff person (and/or contractor) to manage a comprehensive water use reduction program as recommended in this report, with a focus on engaging directly with the Town's highest water users.
3. Expand participation in and optimize use of the Greenscapes North Shore Coalition (and its stormwater collaborative), the Parker-Ipswich-Essex Rivers Partnership (PIE-Rivers) and the regional Ipswich River Drought Task Force to increase Ipswich's overall capacity to manage water neutral growth programs and initiatives.
4. Convene a working group and pursue funding to draft and implement a Comprehensive Water Resources Management Plan (CWRMP) to integrate and plan for all aspects of water resources management needs in the Town.
5. Expand the Town's Water Subcommittee to include members with water conservation, Water Management Act permitting and/or environmental expertise.
6. Help to restore the Town's natural water balance by furthering previous efforts to explore and ultimately implement an alternative discharge location for the Town's treated wastewater to help replenish the Ipswich and/or Parker watersheds.
7. Help to catalyze a regional effort with other communities that depend on Ipswich River water to identify, pursue and secure alternative sources of water to supplement local supplies during periods of water scarcity and reduce the impact of summer withdrawals on the environment.

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LIST OF APPENDICES

APPENDIX 1: SUMMARY LIST OF RECOMMENDATIONS

Land Use Recommendations
Most municipal boards and committees need to become involved in water supply management.
Establish a project review mechanism for municipal staff to communicate regularly about projects and activities that impact water supply and land use and to work together to identify strategies for water neutral growth.
Adopt a Water Neutral Growth Bylaw that requires developments to offset their projected additional water demand to the extent feasible. (See Appendix 3 for Bylaw Model)
Conduct a thorough audit of Ipswich's local zoning and land use regulations to identify opportunities to achieve the benefits of Green Infrastructure and Low Impact Development (LID) utilizing Mass Audubon's Bylaw Review Tool and others (Appendix 6)
Reevaluate the previously created groundwater protection zoning overlay, considering changes to town-wide soil conditions that influence groundwater recharge areas to the public water supply. Enhance development prohibitions that would negatively impact groundwater quantity (and quality). Prioritize the protection of these critical areas through land acquisition and other means.
Amend the subdivision bylaw to make Open Space Development and the maximization of LID techniques the de-facto requirement for all new subdivisions and require traditional subdivisions by Special Permit only. Regulations for consideration should include but not limited to the following provisions: • minimize installation of landscape areas requiring supplemental irrigation beyond what rainfall provides. • limit land clearing and loss of vegetated cover and preserve natural vegetation. • prohibit topsoil stripping and earth removal, require a minimum 6-inch depth of topsoil on all cleared areas. • restrict topographic alterations and require that natural topography be maintained to maximum extent feasible. • preserve/restore a site's natural hydrology using techniques such as LID and open space design. • require the use of low water-use/drought-resistant plants, turf, and landscaping techniques, especially drought-tolerant fescues. • encourage or require the use of native, noninvasive plants, appropriate for the site/selected for their ability to adapt to local climate. • prohibit to extent feasible the installation of sod for lawns; and • prohibit the use of underground irrigation systems with possible exceptions for agricultural l purposes that connect to the municipal system.
Require that any project requiring a building permit that renovates over a certain threshold (e.g. 25%), expands its footprint, and/or disturbs land be subject to a stormwater and land use review and incorporates LID practices to the extent feasible and upgrades water using fixtures
Amend the Town's stormwater bylaw to make any project subject to a building permit meet the State Stormwater Standards and make it applicable to any project within the watersheds of the Town's water supplies, ensure that the new EPA MS4 Permit conditions are complied with and make better use of the Greenscapes Stormwater Collaborative *(with a focus on improving existing conditions).*
Seek to minimize the impact of new connections to the Town's sewage system on the water balance by requiring that any system expansion be required to mitigate for its impacts and seek to reduce the

impact of the current sewer system by implementing new projects that offset this impact.

Recommendations for a Water Use Mitigation Program

Adopt a Water Use Mitigation Program (WUMP draft, Appendix 8) in concert with the Water Use Mitigation Bylaw (Appendix 3). Program should strive to achieve at least a 2:1-gallon offset ratio (offset 2 gal. of existing use for every 1 gal. of new use proposed).

Develop and maintain a prioritized list of WUMP-eligible projects and activities that can qualify for WUMP funds, such that developers can offset their projected use under the water use bylaw and that can be used to pursue grant funding to help implement water use reduction projects.

Help to catalyze a discussion with local towns and partners on the creation of a regional WUMP.

Recommendations for Water Conservation and Use Mitigation Strategies

Expand the Town's existing water conservation program so that it effectively implements all relevant water conservation standards and recommendations in the new *2018 Massachusetts Water Conservation Standards.*

Execute the Town's recently updated Drought Management Plan, once approved by DEP. Updates include consideration of local stream flow trigger(s) so that water restrictions begin sooner and provide for more drought resiliency.

Prioritize the reduction of the Town's Unaccounted for Water Use (UAW) to 10%, with a long-term goal of achieving 6% or less. The Town should partner with the State to conduct an American Water Works Association M-36 Audit to inform a UAW reduction plan, expand its current leak detection program using advanced and automated technologies, and increase resources available to make small leak repairs which can be delayed at the expense of larger ones. Because of the benefit to the municipal system, the public leak detection program should include and prioritize service connections on private property.

Implement the plan to fully utilize all water-reduction tools that the new Smart Meter system makes available.

Maintain the seasonal water pricing structure and investigate other rate structures that would incentivize a reduction of discretionary water use. The public should be intimately engaged in any water rate setting.

Continue to prioritize the water main replacement program to include the mains that use water bleeders to maintain water quality. Eliminate the use of bleeders as soon as possible.

Further subsidize existing water conservation incentive programs (such as the rain barrel subsidy), pay for residential water audits for the top 15% of customers, and offer generous rebates for fixture upgrades that were specifically identified during the audits.

Monitor the Town's Residential Gallons uses Per Capita Per Day (RGPCD) to ensure that it is a steady declining trajectory until it reaches and sustains a level of 42 or less.

Conduct a water audit of all municipal and school buildings and outdoor use, implement measures to maximize the efficient use of water, educate municipal staff on water conservation practices, and prominently interpret water-saving projects and activities to the public.

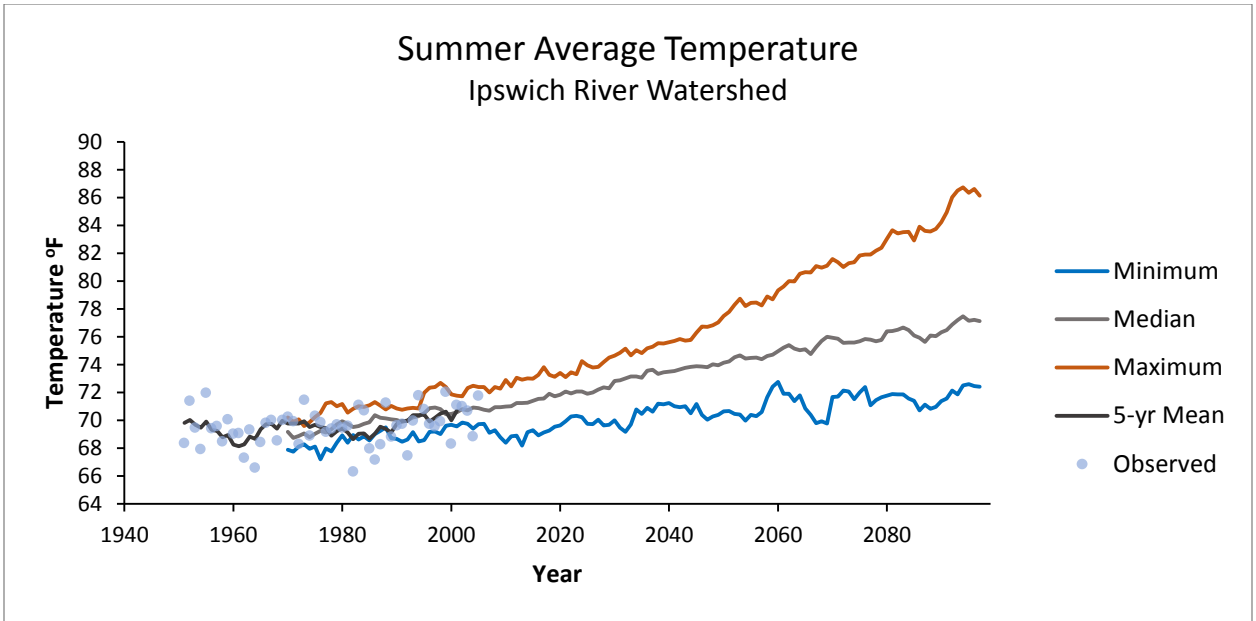
Conduct an individual water use profile analysis of the top 37 commercial users and develop a customized water use reduction program for each. Make water audits available to all commercial customers, with a particular focus on the top 7 users. Engage senior management directly to solicit agreements to pursue aggressive use reduction goals.
In addition to including agricultural use in the measures called for in recommendation 10 above, the Town should engage with the State Department of Agriculture and the US Natural Resources Conservation Service to work directly with individual businesses to recommend and fund implementation of water conservation measures.
As soon as possible, implement the new *Massachusetts Healthy Lawn, Happy Summer Toolkit* amongst all residential customers that show significant discretionary water use according to the water use profile. In addition, engage the top 5% of its residential customers individually to pursue specific water use reduction efforts.
Offer a generous rebate program for the decommissioning of existing underground irrigation systems.
Increase the Town's capacity to enforce its water savings activities and regulations.
The Board of Health should adopt more stringent permitting requirements on the installation of private wells, ensuring adequate water conservation practices. Prohibit new wells in zones of contribution to the Town's water supply watersheds and in stressed sub-basins as designated by the State Water Resources Commission.
Recommendations for New Programs and Capacity
Form an interdisciplinary ad hoc committee to create a Water Supply Resiliency Action Plan to implement these recommendations.
Hire part time staff person (and/or contractor) to manage a comprehensive water use reduction program as recommended in this report.
Expand participation in/optimize use of the Greenscapes North Shore Coalition (and its stormwater collaborative), the Parker-Ipswich-Essex Rivers Partnership (PIE-Rivers), and the regional Ipswich River Task Force to increase Ipswich's capacity to manage water neutral growth programs and initiatives.
Convene a working group and pursue funding to draft and implement a Comprehensive Water Resources Management Plan (CWRMP) to integrate and plan for all aspects of water resources management needs in the Town.
Expand the Town's Water Subcommittee to include members with water conservation, Water Management Act permitting and environmental expertise.
Help to restore the Town's natural water balance by furthering previous efforts to explore and ultimately implement an alternative discharge location for the Town's treated wastewater to help replenish the Ipswich and/or Parker watersheds.
Help to catalyze regional effort with other communities that depend on Ipswich River water to identify, pursue and secure alternative water sources to supplement local supplies during periods of water scarcity.

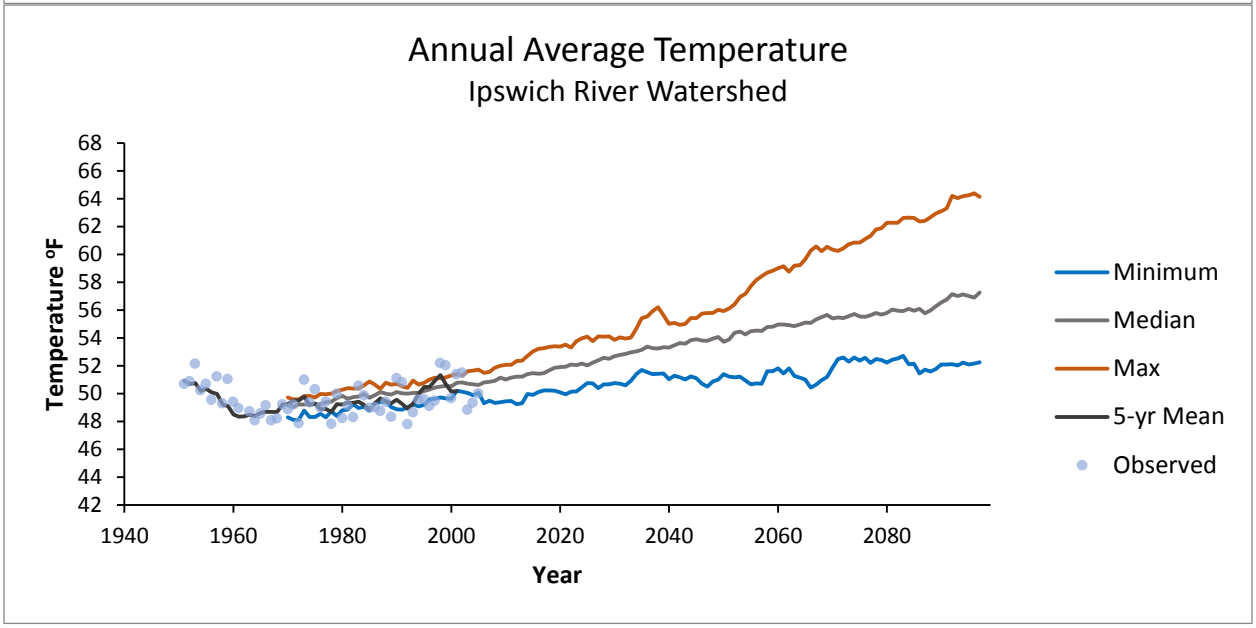
APPENDIX 2: PROJECTED CLIMATE DATA FOR IPSWICH RIVER WATERSHED

The following graphs contain historical climate data and estimated future projections for the Ipswich River Watershed at the Annual and Summer scales. These two time periods were selected to show the projected changes in; average temperature, consecutive dry days, and average precipitation, from year to year and from summer to summer (when the demand for water is at its peak).

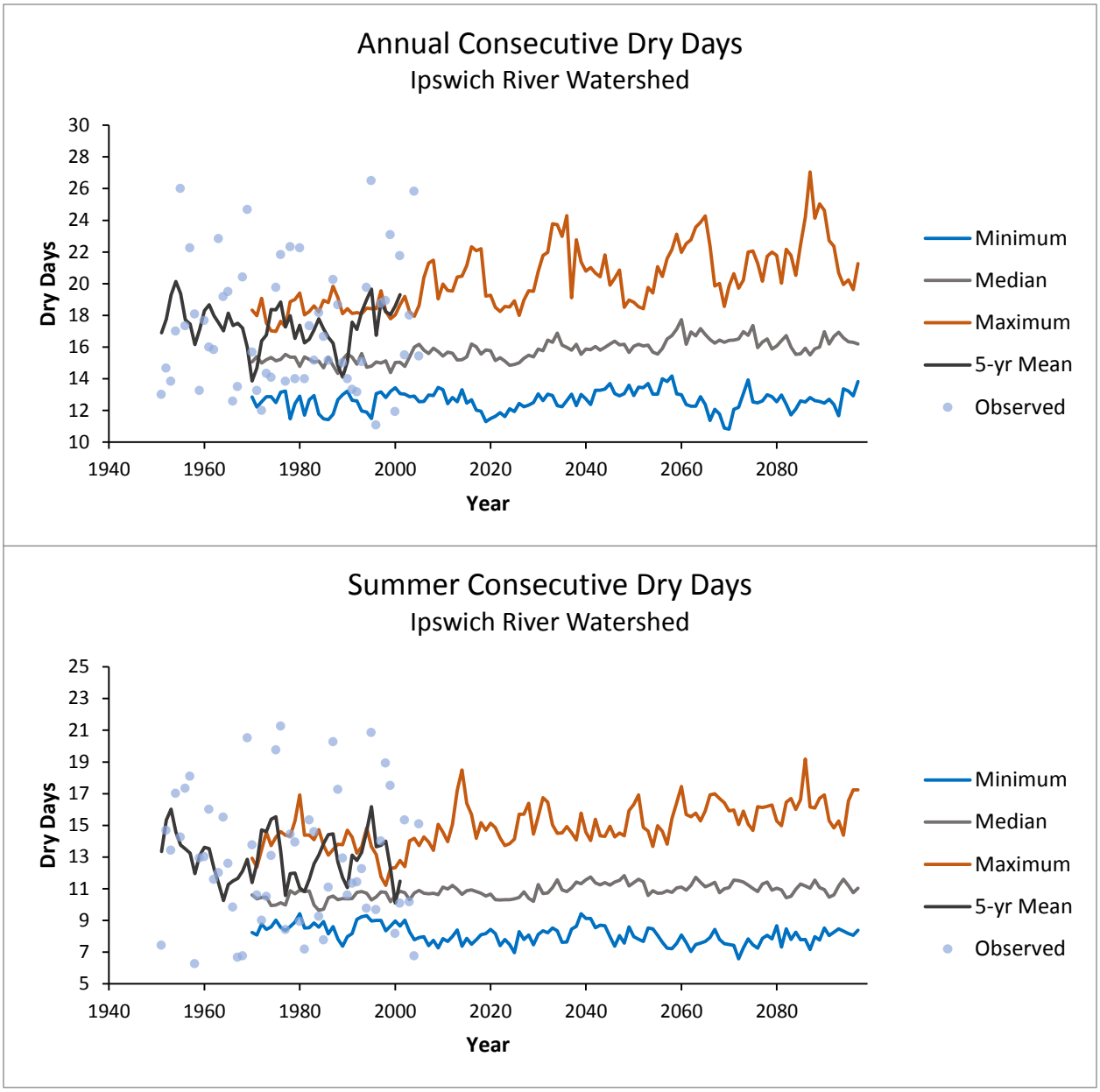
Data was downloaded from The Resilient MA Data-Grapher to create the graphs below. A general explanation of the data is as follows:

> The gray data points are observed data, and [the dark grey] line within the data points is a five-year running mean. The climate change projections, shown in red and blue, are based on 14 climate models and two pathways of future greenhouse gas emissions; a medium and high emissions scenario. This results in a total of 28 projections. The [red line] represents the highest modeled result while the [blue line] represents the lowest modeled result. The light grey boundary line between the two is the median of all the modeled results. (Resilient MA, Video Tutorial)

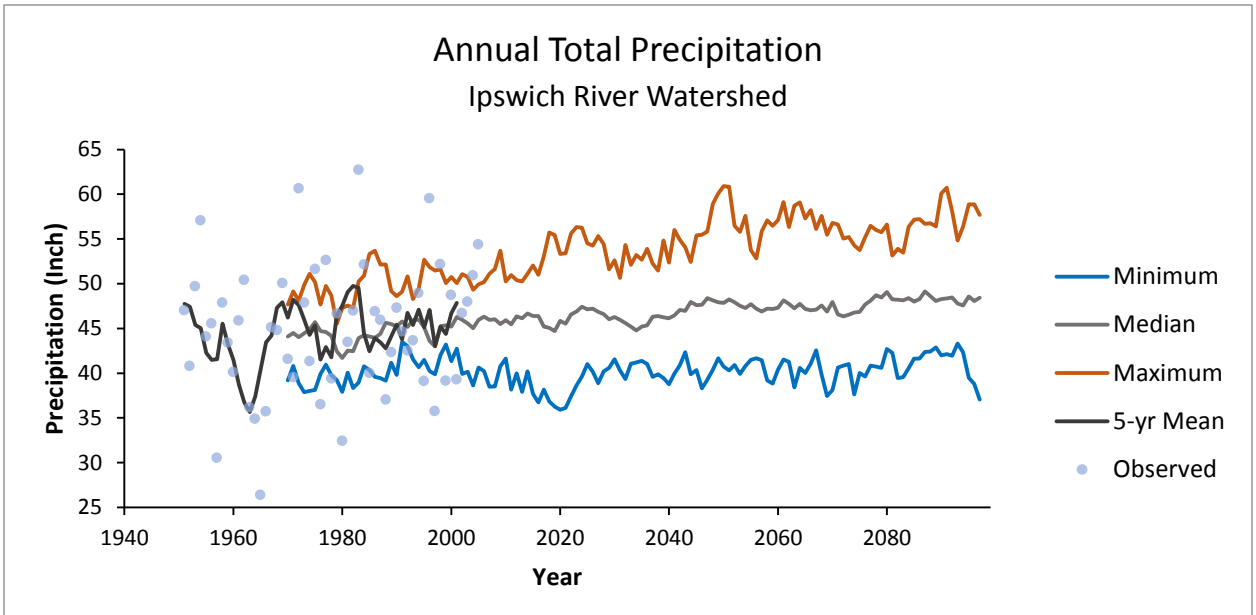


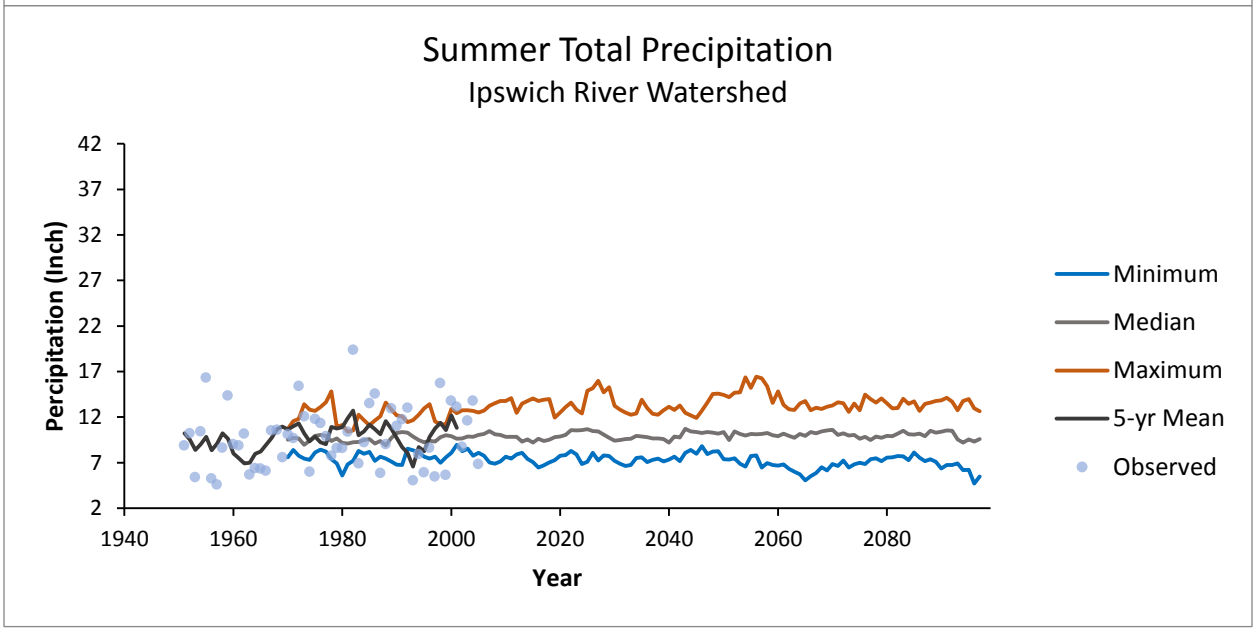


The average temperature maximum, median and minimum models estimate a steady increase in temperature that will be seen at the annual and summer scales. By 2097, it is estimated that the average annual temperature will be between 52.25°F and 64.15°F. The average summer temperature is estimated to be between 72.42 °F and 86.14 °F by 2097.



The maximum modeled projections for consecutive dry days show great variation at the annual and summer scales, though there is an overall increasing trend at the annual level that is visible across all models. Annual maximum projected consecutive dry days range from 17 to 27 dry days and the summer maximum ranges from 11 to 19 consecutive dry days over the 128-year period. The minimum projected annual consecutive dry days range from 10.8 to 14.2 dry days, while the median ranges from 14.4 to 17.7 dry days. Minimum and median projected consecutive dry days for the summer range from 6.5 to 9.4 dry days and 9.6 to 11.8 dry days respectively. Though subtle, the summer maximum and median projections do show an increasing trend on consecutive dry days, while the summer minimum shows a downward trend.





The three models show a projected increase in total annual precipitation. The maximum and median models estimate that there will be an increase in total summer precipitation while the minimum model projects a decreasing trend. While total annual precipitation is anticipated to increase, it is important to note that winters are projected to get wetter as more precipitation will fall as rain or freezing rain due to the increase in temperatures. It may seem contradictory to predict an increase in total precipitation while also predicting a potential increase in consecutive dry days, this is due to an increase in heavy rain events.

APPENDIX 3: MODEL WATER USE MITIGATION BYLAW

[PREVIOUSLY DRAFTED BY THE IPSWICH WATER DEPARTMENT]

PURPOSE:

The purpose of this bylaw is to:

- *Protect and promote the public health, safety, and general welfare*
- *Ensure that there is enough water at all times to meet the basic needs of the community, including fighting fires*
- *Establish and assist in achieving sustainability goals and objectives*
- *Manage the demand for more water in The Town of Ipswich, to ensure that demand for water does not exceed available current or future supply and demand for water does not exceed the sustainable yield of the source*
- *Manage water / water infrastructure to be more resilient to drought*

FINDINGS:

The [entity adopting this bylaw] makes the following findings:

The Town of Ipswich receives water from the Ipswich Basin and the Parker Basin. In 2014, the Massachusetts Water Management Act established the Safe Yield for the Ipswich Basin below the existing water withdrawals, promulgating regulations requiring conservation or offset in order to meet additional demands of development. These facts have been documented in the SWMI Report https://www.mass.gov/service-details/sustainable-water-management-initiative as well as the Kleinfelder Reports https://lcwd.us/other-resources/ipswich-river-basin-reports/ .

Continuing to add new development under current conditions would increase the demand on the water supply, thereby increasing risk to the public health, safety, and general welfare. If water use exceeds the sustainable yield of the river basins, results will include:

- *A danger that there will not be enough water at all times to meet the basic needs of the community, including fighting fires*
- *Adverse impacts on the community, including current and future residents*
- *Adverse impacts on public recreation or other social or economic impacts*
- *Adverse impacts on the environment, fish and wildlife*
- *Adverse impacts on the value of the resource to the public*

In order to ensure the availability of water for residential, commercial, and other purposes, for present as well as for future use in the Town of Ipswich, it is necessary that the increase in water usage in the areas defined herein be managed to the best extent practicable.

AUTHORITY:

The [entity adopting this bylaw] adopts this bylaw under the authority of [name of the law, citation].

REQUIREMENT AND APPLICABILITY:

An application concerning development within The Town of Ipswich that would use water from the Ipswich public water supply shall not be approved if the proposed development would increase water use on the property, unless the applicant offsets the requisite amount of water demand via one or more of the methods in this bylaw.

This bylaw shall not apply

- *To applications approved prior to adoption of this bylaw*

DEFINITIONS:

***"Alternative Sources of Water Supply"** – A water source that an applicant can use in lieu of the water from the provider at issue in this bylaw. Use of alternative sources of water supply will reduce the amount of water usage required to be offset. These sources include, but are not limited to:*

- *Reused graywater*
- *Captured rainwater / stormwater*

Water from a private well does not qualify as an "alternative source of water supply."

***"Applicant"** – Any person submitting an application.*

***"Application"** – A request for:*

- *A building permit*
- *Subdivision approval*
- *Site plan approval*
- *A conditional use permit*
- *A change of use permit*
- *A water hookup*
- *Water service via annexation*
- *A remodel approval*
- *A certificate of occupancy*

***"Offset Credit"** – The amount of water, in identified units (e.g., gallons per year), saved via fixture replacements and other water-saving measures that reduces the demand for water from the provider at issue in this bylaw.*

***"Development" –** Any land use, alteration of land, construction, reconstruction, structural alteration, and any change in the use, including intensification, of any building or other structure.*

***"Infrastructure Capacity"** – The amount of demand that can be safely and reliably handled by the existing water and wastewater treatment, distribution, and transport system.*

***"Net Increase in Water Demand"** – The expected total water use due to the proposed development (once construction is completed and excluding temporary demands such as for landscape establishment), minus the amount of existing water use, onsite credits (if available), and alternative sources of water supply.*

***"Person"** – Any individual, firm, partnership, association, corporation, company, trust, organization, or governmental agency, and any officer, employee, or agent of said person, and any group of said persons.*

***"Remodel"** – Any alteration to an existing structure that requires a permit or other governmental approval.*

"Sustainable Yield" *– The maximum amount of water that can be withdrawn from a source during a defined period and still provide a dependable supply and not lead to economic, social, or environmental consequences considered to be unacceptable.*

"Water Source" *– An aquifer, stream, river, lake, or other natural or artificial collection of water from which water can be lawfully withdrawn and put toward the desired purpose.*

DETERMINING THE OFFSET AMOUNT: (SEE WATER USE MITIGATION BYLAW)

PROJECTING THE NET INCREASE IN ANNUAL WATER DEMAND

The applicant shall provide a detailed projection of total annual water demand resulting from the proposed development, excluding temporary demands such as for landscape establishment. This projection must use the identified formula, calculator, or other guidance, be supported by reliable engineering data, and include complete descriptions of all proposed land uses. The Ipswich Water Director will review the applicant's projection and may apply the projection if it finds, after review, that the projection is accurate. If the Ipswich Water Director finds the applicant's projection to be incomplete, inaccurate, or otherwise erroneous, it must deny the application and return it to the applicant with an explanation of the denial.

The local government may maintain and update a water demand projection formula for specific fixtures, appliances, and other common water-using elements for residential or non-residential development.

To determine the net increase in annual water demand resulting from the proposed development, the total projected annual water demand shall be reduced by the property's existing average annual water demand, if any, on the water provider. The Ipswich Water Director will determine this amount based on the average annual use in the two years of highest water use in the preceding ten years, the amount of water usage previously offset, or the flow rates and flush volumes of existing fixtures, whichever is feasible or produces a higher result.

The total projected annual water demand of the proposed development also shall be reduced by the amount of water from alternative sources, if any. The applicant shall provide information on the alternative source(s) of water supply, including the capacity or annual volume, in the application. The Ipswich Water Director shall verify the average annual amount of water from alternative supplies that the proposed development will use. If proposed amount is verified, the reduction will be made from the projected net increase in annual water demand.

CALCULATING THE OFFSET AMOUNT FROM THE PROJECTED NET INCREASE IN ANNUAL WATER DEMAND

If it is determined that the proposed development likely will result in a net increase in water demand, the applicant will present calculations of the amount of water usage that will need to be offset, which shall be reviewed and approved by the Ipswich Water Director.

Calculations shall multiply the projected net increase in annual water demand for the proposed development by [X percent], in light of the current and projected water supply and:

- *Allowing for a margin of safety in calculation*
- *Considering the water needed for community health and safety purposes, such as firefighting and fire hydrant testing*
- *Considering system losses and maintenance uses*

- *Considering the need to protect the ecological health of the water source*

The resulting figure is the amount of water demand that must be offset by off-site activities using the methods below.

IDENTIFYING THE OFFSET ACTIVITIES:

The following fixture replacements and other projects can qualify for offset credits:

- *Single-family toilet replacements*
- *Multifamily toilet replacements*
- *Nonresidential toilet replacements*
- *Single-family showerhead replacements*
- *Single-family clothes washer replacements*
- *Multifamily common area clothes washer replacements*
- *Laundromat clothes washer replacements*
- *Commercial dishwasher replacements*
- *Pre-rinse spray valve replacements*
- *Commercial food steamer installations*
- *Cooling tower efficiency management*
- *Irrigation system efficiency*
- *Turf removal*
- *Graywater system installation in new construction*
- *Installation of rainwater or stormwater recovery systems*
- *Leak correction*
- *Reduced water consumption on irrigated agricultural lands*
- *Such other offset projects as may be approved in advance by the Ipswich Water Director, upon a documented submittal by the applicant showing equal or superior performance and durability to those fixture replacements and projects enumerated herein.*

The Ipswich Water Director shall develop and maintain a table of offset credits to be provided for each qualifying fixture replacement or project.

To ensure that the fixture replacements and other projects create capacity where needed to accommodate the development, the fixture replacements and other projects must be implemented on the property of other users of the source at issue within the watershed. Whenever practical, fixture replacements shall be conducted for the entirety of a structure, but partial retrofits of structures are eligible for offset credits.

Offset credits shall not be recognized for fixture replacements and other projects if they are:

- *Otherwise required by law*
- *Not approved by the Ipswich Water Director*

The applicant shall describe in the application how it will meet its offset requirement. The application shall not be approved until the Ipswich Water Director determines that the applicant can meet its offset requirement within the time allotted.

COMPLIANCE WITH THE OFFSET:

VERIFICATION:

Upon completion of all fixture replacements and other projects necessary to meet the offset requirement, the applicant shall submit a list of the tasks completed to the Ipswich Water Director. The Ipswich Water Director and/or Plumbing Inspector will verify that the fixture and appliance replacements were completed. Inspections may occur before, during, and after the fixture and appliance replacements and implementation of other projects.

MONITORING:

The [applicant/successor owners/water utility] shall monitor and record the water usage of the development [monthly/annually for X years] after occupancy, or, in the case of phased development or multi-tenant structures, after [X percent occupancy], to demonstrate whether the water demand is what was projected. Monitoring results shall be reported to the Ipswich Water Director.

ENFORCEMENT:

Remedies for failing to comply with the requirements of this bylaw include:

If the water usage monitoring required by the prior section of this bylaw reveals that the development exceeded the water demand projected, the Ipswich Water Director shall notify the applicant/HOA/condo association/owner. Monthly monitoring will be used to determine whether water usage by the development has been sufficiently reduced. If, after [X months], water usage by the development is at or below the projected amount, the applicant/HOA/condo association/owner shall be so informed. If, after X months, water usage of the development remains in excess of the projected amount, the identified official shall notify the applicant/HOA/condo association/owner of this exceedance, recalculate the water demand of the development based on actual usage over the period of excessive use, and inform the applicant/HOA/condo association/owner of the amount of additional water usage that will need to be offset through on-site or off-site fixture replacements or other projects. If sufficient fixture replacements and other projects necessary to meet the offset requirement have not been completed, as approved by the identified official, within X days after notice of the additional offset requirement, the applicant/HOA/condo association/owner will be subject to the enforcement measures above.

[IN-LIEU FEE] WATER USE MITIGATION FUND:

The [identified official] may authorize payment to [the Ipswich Water Use Mitigation Fund] of an in-lieu fee equivalent to the cost of offsetting the requisite amount of net increase in water demand. The exact fee shall be calculated by the identified official to include the full administrative cost to accomplish the required offsets. The fee must be paid before the application is approved.

ADMINISTRATIVE FEES:

In addition to other fees required by law, all applications shall include a:

The amount of the fee will be set by the [identified official] and due to the [identified official]. If the [identified official] determines that, without offsets, the proposed development likely will not result in a net increase in water demand on the system at issue, the fee shall be refunded to the applicant. If the [identified official] determines that the proposed development likely will result in a net increase in water demand on the system at issue, the fee shall thereafter be nonrefundable.

MODIFICATIONS:

If, due to special circumstances, imposing a requirement of this bylaw would be inequitable or constitute an undue hardship, the applicant may request that the requirement be modified. A request for a

modification must be submitted concurrently with the application. In the request, the applicant shall provide the factual and legal basis for the claim, including all supporting technical documentation.

The [identified official or commission] shall review the request at the same time as the application and grant, conditionally grant, or deny the request for a modification. A request for a modification will be denied unless the [identified official or commission] finds, based on the information provided in the request, together with such additional information as may be requested, and the water use information for the property, all of the following:

- *Because of special circumstances, strictly applying the requirement or requirements at issue would be inequitable or constitute an undue hardship;*
- *The modification does not constitute a grant of special privilege;*
- *Authorizing the requested modification will not be of substantial detriment to adjacent properties, will not materially affect the ability to effectuate the purposes of this bylaw, and will not be detrimental to the public interest;*
- *The special circumstances which are the basis for the modification being sought are not common, recurrent, or general in nature; and*
- *The applicant has achieved the maximum practical reduction in water use.*

The [identified official or commission] shall provide prompt written notice of the decision to the applicant and those who have requested notice.

APPEALS:

[Identified categories of persons or entities] may appeal:

When a party disagrees with a decision made under this bylaw, completion of this administrative appeals process is essential to that decision being final for purposes of judicial appeal.

SEVERABILITY:

If any section, subsection, sentence, clause, phrase, or portion of this bylaw is for any reason held to be invalid or unconstitutional by the decision of any court of competent jurisdiction, such decision shall not affect the validity or constitutionality of the remaining portions herein. The entity adopting this bylaw hereby declares that it would have passed each section, subsection, sentence, clause, phrase, or portion of this bylaw, irrespective of the fact that any one or more sections, subsections, sentences, clauses, phrases, or portions be declared invalid or unconstitutional.

CONSISTENCY WITH OTHER LAWS:

This bylaw shall not affect:

EFFECTIVE DATE:

This bylaw shall take effect:

APPENDIX 4: POTENTIAL WATER USE MITIGATION PROGRAM FEE CALCULATIONS

This appendix includes sample calculations for estimating the fee generation potential of a theoretical Water Use Mitigation Program (WUMP) based on the last 5 years of Planning Board permitting activity in Ipswich. Since there are a myriad of potential assumptions and specific fees that could be chosen based on the specific recommended WUMP, only a sample is included here for illustration purposes. The sample does not include smaller projects not subject to Planning Board review nor projects subject to Zoning Board of Appeals (ZBA) review which would theoretically be exempt from a WUMP.

Residential Development Projects permitted by the Planning Board 2015-2019 (five years)				
Address	*Units*	*Bdrms/unit*	*Constructed?*	*Hypothetical Payment*
199 High	10	2	Yes	$20,000
30 South Main	11	2	Yes	$22,000
48 Market	8	1	Yes	$8,000
62 Central	7	5 2bd, 2 3bd	Yes	$16,000
20 Broadway	4	3 1bd, 1 2bd	Yes	$5,000
15 Market	3	1	Yes	$3,000
51-61 Market	3	2	No	$6,000
178 Linebrook (Symes Phase 1)	16	3	No	$48,000
				$128,000
Residential Projects currently before the Planning Board				
173 Linebrook (Symes Phase 2 & 3)	35	3	No	$105,000
Riverbend addition	11	1	No	$11,000

$244,000 **TOTAL**

This fee applies to residential projects of three or more units

Water Use Mitigation Charges

Charges shall be assessed to projects in accordance with the following fee schedule and are in addition to connection permit fees:

Project Type	Fee
Residential – 1 Bedroom	$1,000/unit
Residential – 2 Bedroom	$2,000/unit
Residential – 3 Bedroom	$3,000/unit
Residential – 4 Bedroom	$4,000/unit
Commercial	$5.00/gpd[1]

[1]Gallons per day volume to be defined per Title 5

Commercial Projects Permitted by the Planning Board 2015-2019

Address	*Type*	*Square feet*	*Constructed?*	*Title V flow estimate**
95 Turnpike			New construction	
23 Old Right Road	Addition		Yes	
9 Nags Head	New construction		Yes	
112 County	Pool		Yes	
116 County	New tenant old building		Yes	
116 County	New construction		Yes, not occupied	
113 Central	New tenant old building		Yes	
49 Turnpike	New construction		Yes	
Hayward Street	Addition		No	
20 South Main	Addition		Under construction	
78 Turnpike	New tenant old building		Yes	
75 Turnpike	New tenant old building		Yes	
116 County	New construction		Yes	
78 Turnpike	New construction		Yes	
75 Turnpike	New tenant old building		Yes	
59 Turnpike	New construction		No	
143 High	New construction		Under construction	
14-16 Mitchell Road	Addition		No	

**calculations not completed for commercial sector*

APPENDIX 5: ESTIMATED WATER SAVINGS CALCULATIONS

To help the Town estimate potential water savings and evaluate the relative cost benefit of implementing water savings activities, order of magnitude estimates of potential water savings were calculated. The estimates were developed based on savings realized in other communities due to the implementation of similar measures and informed by the professional experience of staff at the Ipswich River Watershed Association. Relevant water conservation resources were also consulted to inform estimates including the MA Water Conservation Standards, EPA's Water Sense Program, The American Water Works Association Water Use Conservation Handbook (Vickers 2001), The Alliance for Water Efficiency as well as direct consultation with State Water Program staff in the Executive Office of Energy & Environmental Affairs, Department of Conservation & Recreation, Division of Ecological Restoration and the Department of Environmental Protection.

It is important to note that actual water savings based on implementation of any specific measure can vary widely and is dependent on many factors. These factors include the existing water conservation programs and culture in town, the degree of implementation of individual measures, enforcement, availability of education & technical assistance programs, incentives and disincentives, staffing resources, funding, amount and pattern of local development, etc. Moreover, as a relatively progressive water conservation community, estimates informed by the literature and results experienced in other communities need to be adjusted for Ipswich accordingly. Additionally, the realized savings will likely vary over time and space and could diminish over time as the low hanging fruit measures are implemented and water conservation becomes more of a cultural norm. As such, these estimates should not be viewed as being predictive or having a high degree of rigor and are thus provided for illustration and planning purposes only.

The following is a subset of the table of recommendations located in Appendix 1 where a savings estimate could reasonably be calculated based on implementation of that recommendation. Unless otherwise indicated, calculations are based on average water use in 2017 & 2018 which were "normal" years meteorologically. It should be noted that many of the other recommendations in Appendix 1 not on this list, which consist largely of planning and procedural measures, as well as measures to protect the resiliency of the town's water supply could technically yield additional water savings but were not amenable to estimating quantitatively. As such, these estimates could be considered conservative. Potential water savings fall into two categories: preventative (P) based on reducing projected future new demand and actual (A) which are based on reducing exiting use. The calculations for each measure were done in consideration of the interdependence of some of the measures to avoid double counting. Water savings estimates are provided in millions of gallons per year (MGY) and it should be noted that many of these estimates are seasonally influenced and as such need to be considered when relating to projections and relative impact of each measure.

Land Use Recommendations	P/A	Range (MGY)	Ipswich Estimate
Adopt a Water Neutral Growth Bylaw that requires developments to offset their projected additional water demand to the extent feasible. (See Appendix 3 for Bylaw Model). See note **A**	P	NA	0.786
Require that any project requiring a building permit that renovates over a certain threshold (e.g. 25%), expands its footprint, and/or disturbs land be subject to a stormwater and land use review and incorporates LID practices to the extent feasible and upgrades water using fixtures. **B**	P		1.330
Recommendations for a Water Use Mitigation Program			
Adopt a Water Use Mitigation Program (WUMP draft, Appendix 8) in concert with the Water Use Mitigation Bylaw (Appendix 3). Program should strive to achieve at least a 2:1-gallon offset ratio (offset 2 gal. of existing use for every 1 gal. of new use proposed). **C**	A	NA	NA
Recommendations for Water Conservation and Use Mitigation Strategies			
Expand the Town's existing water conservation program so that it effectively implements all relevant water conservation standards and recommendations in the new *2018 Massachusetts Water Conservation Standards.* **D**	A & P	NA	NA
Prioritize the reduction of the Town's Unaccounted for Water Use (UAW) to 10%, with a long-term goal of achieving 6% or less. The Town should conduct an M-36 Audit to inform a UAW reduction plan, expand its current leak detection program using advanced and automated technologies, and increase resources available to make small leak repairs which can be delayed at the expense of larger ones. Because of the benefit to the municipal system, the public leak detection program should include and prioritize service connections on private property. **E**	A	14.21 - 37.61	26.25
Implement the plan to fully utilize all water-reduction tools that the new Smart Meter system makes available. **F**	A & P	3.37 – 4.18	3.375
Maintain the seasonal water pricing structure and expand it to the commercial sector. Adopt a hardship provision that would exempt entities that can demonstrate that water use is an essential component of their business and that complying with the rates would pose an economic burden. **G**	A	.339 - .957	0.648
Investigate an increasing block rate price structure with a sufficient number of blocks to incentivize the reduction in discretionary water use. Engage the public in any water	A	0.866 – 2.599	1.300

rate setting. **H**			
	P/A	**Range (MGY)**	**Ipswich Estimate**
Continue to prioritize the water main replacement program to include the mains that use water bleeders to maintain water quality. Eliminate the use of bleeders as soon as possible. **I**	A	NA	2.102
Further subsidize existing water conservation incentive programs (such as the rain barrel subsidy), pay for residential water audits for the top 25% of customers, and offer generous rebates for fixture upgrades that were specifically identified during the audits. **J**	A	1.76 – 5.16	1.76
Conduct a water audit of all municipal and school buildings and outdoor use, implement measures to maximize the efficient use of water, educate municipal staff on water conservation practices, and prominently interpret water-saving projects and activities to the public. **K**	A	0.208 – 1.043	0.417
Conduct an individual water use profile analysis of the top 37 commercial users and develop a customized water use reduction program for each. Make water audits available to all commercial customers, with a particular focus on the top 7 users. Engage senior management directly to solicit agreements to pursue aggressive use reduction goals. **L**	A	2.410-9.639	7.210
In addition to including agricultural use in the measures called for in recommendation 10 above, the Town should engage with the State Department of Agriculture and the US Natural Resources Conservation Service to work directly with individual businesses to recommend and fund implementation of water conservation measures. **M**	A	0.308-3.076	1.538
As soon as possible, implement the new *Massachusetts Healthy Lawn, Happy Summer Toolkit* amongst all residential customers that show significant discretionary water use according to the water use profile. In addition, engage the top 5% of its residential customers individually to pursue specific water use reduction efforts. **N**	A	3.434-5.283	4.358
Offer a generous rebate program for the decommissioning of existing underground irrigation systems. **O**	A	N/A	0.527
Increase the Town's capacity to enforce its water savings activities and regulations. **P**	A	N/A	N/A
Recommendations for New Programs and Capacity			

	P/A	Range (MGY)	Estimate
Hire part time staff person (and/or contractor) to manage a comprehensive water use reduction program as recommended in this report. **Q**	A	N/A	N/A
Total:		31.123 –74.292	51.601

Calculation Notes:

A. Calculation based on assumption that new water use bylaw achieves net zero water growth as required in the bylaw and is derived from the average annual residential and commercial growth subject to planning board review during the 5-year period as shown in Appendix 4 between 2015-2019. Residential = 544,872 + commercial = 240,900 total 785,772 gallons per year. Calculations represent normal level of construction activity in a given year and does not include large one-time new commercial water users which occur infrequently such as the Y water park or true North Ale which occurred during the 5-year period used in these calculations.

B. Based on average single-family home/condo development per year not subject to Planning Board review. 33 units x 2.3 people x 48 gpcd = 1,329,768 gallons.

C. Water savings achieved by the WUMP are located adjacent to the specific activity that would be paid for by the program (e.g. fixing leaks, offering rebates, funding a water conservation coordinator, etc.).

D. Although this measure will produce quantifiable water savings, savings achieved by a comprehensive water conservation program are located elsewhere in the table associated with the specific activity.

E. Calculated by subtracting the towns reported unaccounted water loss over each of the 5 years between 2014-2018 from the recommended goal of 6%. Based on assumption that the reported rate of unaccounted water in Ipswich are real losses which Town staff indicate is mostly the case. Range is the low of 14.21 MGY in 2014 vs. the high of 37.61 MGY in 2018 and estimate is the 5-year average.

F. Estimate based on Smart meter tools implementation estimates in literature. Two estimates calculated: preventative by catching leaks sooner and actual to allow customers to identify inefficient water use. Assumes meter has relatively high sensitivity and includes outdoor leaks. Calculations net of leaks that would have been caught without smart meter. Leaks: 1% of customers detect leaks annually X 0.25 GPM avg. leak X 7 days = 2,835,000 GPY. Inefficient water use reductions: 7.5% of water users amenable to smart meter feedback X 2-5% range of water savings: 27 MGY x 0.02 = 0.54 MGY – 27 x 0.05 = 1.35 MGY. 2% assumed for Ipswich.

G. Assumes 75% of commercial water customers convert to seasonal rate structure and 25-75% of the savings previously experienced with the residential sector occurs in the commercial sector. Based on 2017 & 2018 commercial use data. 12,759,888 MGY X 0.25 X 10% water savings = 318,997 or 12,759,888 MGY X .75 X 10% = 956,992

H. Assumes addition of increasing blocks covering top 25% of residential water users and that would reduce water use by those customers between 1-3%. Based on 2017 & 2018 data. 86,623,013MGY X 0.01 = 866,230 or 86,623,013 X 0.03 = 2,598,690. Estimate for Ipswich is based on 1.5% since price elasticity is estimated to be less in Ipswich than the literature due to the seasonal rate structure already in place and the assumption that the town will implement other measures recommended here.

I. Assumes 2 bleeders used at 2 GPM bled continually = 2,102,400 GPY

J. Based on savings realized through residential audit and rebate programs of 1-3%: 172 MGY X 0.01= 1.72MGY – 172MGY X 0.03 = 5.16MGY. 1% chosen for Ipswich.

K. Based on savings range of 5-25%. Calculation: 4.171MGY X 0.05 = 0.208 – 4.171MGY X 0.25 = 1.043. 10% used for Ipswich.

L. Based on savings range of 5-20%. Calculation: 48.195MGY X 0.05 = 2.410 – 48.195MGY X 0.20 = 9.639. 15% used for Ipswich.

M. Based on savings rates of 2-20%. Assumes 20 of Ipswich's commercial accounts are agricultural as follows: 1 of top 1%, 10 in top 10% and 5 in top 25% and 4 in top 50%. Median use for each sector used in calculations. Calculations: 15.38 MGY X 0.02 = 0.308 – 15.38 MGY X 0.2 = 3.076. Assumed 10% for Ipswich.

N. Based on range of savings in comparable towns in Massachusetts when tool kit was implemented of 39-128 GPD. Assumes range of 39-60 GPD per lawn water user could be saved in Ipswich, that lawn watering uses 25% of residential water and that 15% of residential customers water their lawns = 587 waterers. Assumes 172.030 MGY X 0.25 = 43.007 MGY used for lawns at 150 watering days = 0.287 MGD used in Ipswich for lawn watering. 39 GPD X 587 lawn waterer X 150 days = 3.434 MGY – 60 GPD X 587 X 150 = 5.283 MGY.

O. Assumes 20% of lawn waterers have irrigation systems (117 systems), that the average system uses 2250 gallons per week and that 10% of systems would be de-commissioned. Calculations: 2250 X 20 weeks X 117 X 0.1 = 526,500.

P. Enforcement will lead to water savings, but the amount cannot easily be quantified. Assumes increased enforcement will help to realize and sustain relevant estimates calculated for other measures.

Q. Having a dedicated person or contractor will lead to water savings but the amount cannot easily be quantified. Assumes dedicated capacity will help to realize and sustain relevant estimates calculated for other measures.

APPENDIX 6: COMPILATION OF LID BYLAW REVIEW TOOLS AND OTHER RESOURCES

- Mass Audubon's Bylaw Review Tool for LID and Climate-Smart, Nature-Based Solutions: www.massaudubon.org/content/download/19238/272601/file/LID-fact-sheet-4-lid-in-regulations_revised.pdf
- The Metropolitan Area Planning Commission also has resources available to assist in bylaw review, including www.mapc.org/resource-library/do-your-local-codes-allow-lid/ and www.mapc.org/resource-library/introduction-to-local-stormwater-bylaws-and-low-impact-development/
- Model bylaws for Low-Impact Development and Open Space Design/Natural Resource Protection Zoning: www.mass.gov/envir/smart_growth_toolkit/index.html
- Smart Growth Toolkit, LID for Developers and Planning Boards https://www.mass.gov/smart-growth-smart-energy-toolkit-module-slideshows

Assistance for completing these extensive bylaw reviews can be found in funding opportunities such as the State's MVP Action Grants or EEA planning grants:

- www.mass.gov/service-details/ensuring-success-webinars-municipal-vulnerability-preparedness-mvp-programs-tool See Webinar 5

It is important to note that LID-related requirements can be anywhere in your town, including subdivision, land disturbance, zoning, stormwater, wetlands, health, planning bylaws. Good examples of communities that have completed bylaw evaluations include the following:

- Analysis of entire local code environment (Grafton) https://www.grafton-ma.gov/planning-department/pages/low-impact-development-study
- Targeted analysis of specific code citations (Southborough) www.southboroughtown.com/sites/southboroughma/files/uploads/lid_bylaw2015.pdf

A study was completed to evaluate the feasibility and opportunity to use green infrastructure to improve drought resilience, as done by the Horsley Witten Group for the Environmental Protection Agency in 2017:

- https://www.epa.gov/sites/production/files/201904/documents/epa_gi_for_drought_resilience_report_6-30-17_final_-_508.pdf

APPENDIX 7: SELECTED RESULTS OF WATER USE MITIGATION PROGRAM EXAMPLES LOCALLY AND NATIONALLY

LOCAL WUMP EXAMPLES:

The Town of Danvers Water Bank

The Town of Danvers is required by their Massachusetts Water Management Act permit to institute and manage a Water Use Mitigation Program (WUMP). This program requires the establishment and collection of a fee from any new development, commensurate with the calculated cost to remove two gallons of water use in the Danvers System for each gallon of additional water demand the project adds to the system. The Town's Water Withdrawal Permit requires the Town to expend the collected fees to reduce water system demand and to document these reductions to State officials.

1. *When and why did the program start?*

   Danvers' WUMP started in 2008 as required under the Massachusetts Water Management Act. The program applies to:

   a. projects that require a building permit;

   b. projects that represent a new or increased water demand;

   c. residential projects of 3 or more dwelling units;

   d. all commercial projects.

2. *What are the basic components and operation?*

   New developments are required to pay a WUMP Impact Fee. The fee is based on the calculated cost of removing two gallons of water from the Town's water system use in the Danvers system for each gallon of water added to the water system by the new development. Thus, the program's offset ratio is 2:1.

   Residential buildings projects incur fees based on the number of bedrooms in a dwelling unit ($1,980 per bedroom) while commercial and industrial projects incur fees of $9.00/gpd and demands are based on *Massachusetts Title 5, 314 CMR 7.15: Calculation of Flows*. The fee schedule is as follows:

   Residential - 1 Bedroom $1,980/unit
   Residential - 2 Bedroom $3,960/unit
   Residential - 3 Bedroom $5,940/unit
   Residential - 4 Bedroom $7,920/unit
   Commercial and Industrial $9.00/gpd

   For the new development to be connected to the public water supply system, it must meet three requirements:

   a. Must meet all applicable provisions of the state plumbing code;

   b. Faucets, shower heads, washing machines, dishwashers, and toilets must be energy efficient, water saving and meet the EPA's Water Efficiency Standards;

c. In-ground irrigations systems must be equipped with a rain and moisture sensing device.

3. *What departments have a role in the program? Does the Planning Department? Does the Zoning Board? If yes, in what ways do they participate?*

The Department of Public Works administers the program, executes the water use mitigation projects under the direction of the Public Works Director, and is in charge of estimated water savings from the program. Reports on the water savings are provided to Massachusetts Department of Environmental Protection in the form of an annual statistical report. Other Boards do not seem to have a specific role other than consultation as needed.

4. *What water savings do they see?*

The Massachusetts Water Conservation Standards (July 2018) reports that since the program's inception, Danvers has collected impact fees totaling nearly $1million dollars, has processed approximately 2,000 rebates, and has estimated annual water savings ranging from 946,000 gallons (in 2018) to 2.5 million gallons (in 2010). See below for more detail.

Water Savings Calculations - Town of Danvers | Department of Public Works

Table 3: Rebate Breakdown By Product Type

Fiscal Year	Toilets (1.28 gpf)	Toilets (1.6 gpf)	Clothes Washer	Shower	Faucet	Rain Sensor
2009	46		171	4	10	0
2010	29	31	261	13	35	4
2011	51	19	183	4	15	5
2012	65	22	178	7	20	1
2013	58	12	156	8	32	0
2014	51	7	158	9	19	0
2015	39	6	103	7	17	0
2016	37	1	59	11	29	1
2017	35	2	49	10	26	2
2018	27	7	41	13	35	0

Table 4a: Water Savings By Product by Year

	Toilets (1.28 gpf)	Toilets (1.6 gpf)	Clothes Washer	Shower	Faucet	Rain Sensor	
Savings (GPD)	37	33	15.4	18.8	13.9	23.5	Annual Total
Rebate	$200	$150	$200	$50	$50	$100	
Cost/Gallon Saved	$5.41	$4.55	$12.99	$2.66	$3.60	$4.26	
Fiscal Year							
2009	1,702		2,633	75	139	-	1,660,604
2010	1,073	1,023	4,019	244	487	94	2,533,210
2011	1,887	627	2,818	75	209	118	2,092,691
2012	2,405	726	2,741	132	278	24	2,301,435
2013	2,146	396	2,402	150	445	-	2,021,954
2014	1,887	231	2,433	169	264	-	1,819,343
2015	1,443	198	1,586	132	236	-	1,312,212
2016	1,369	33	909	207	403	37	1,079,488
2017	1,295	66	755	188	361	74	999,735
2018	999	231	631	244	487	-	946,190
					Program Total =		16,766,859

Source: Town of Danvers Water Rebate Tracking sheet by fiscal year

5. *Are there specific criteria for how the money can be spent? Who oversees/audits that and how are the savings quantified? (Per project)?*

   The Fee Utilization Guidelines (effective November 1, 2007) specify how the collected fees are to be expended in accordance with the Massachusetts Law on Revolving Funds (M.G.L. Chapter 44, Section 53E1/2). Link to the guidelines: https://www.danversma.gov/documents/wump-policy/
   The fees are to be used for conserving water resources and reducing demand on the public water supply. These reductions are documented and reported to the State. Payments are made to the Department of Public Works prior to the issuance of a building permit. Where it is not paid prior to this, it will be added to the customer's water bill. The collected funds are forwarded to the Town Treasurer who deposits it into a designated Water Usage Mitigation Fund. In FY'16 the Danvers WUMP funded the cost of an internal audit of the program.

   The DPW can withdraw and expend the WUMP Impact funds up to an annual expenditure limit of $200,000 in accordance with the approved uses. In recent years, the Danvers WUMP has funded: residential and commercial water rebates (on toilets, washing machines, faucets, shower heads, and wireless rain sensors); leak detection programs; irrigation systems, including a large cistern irrigation system at the high school; water bubblers; rain barrels and compost bins; advertising and outreach materials; an internal audit expense, and more. For both residential and commercial water rebates, water rebate dollar amounts range from $25 to $200 depending on the water conservation achieved.

6. *How is the program working now? Has it been more difficult to find water savings as time has gone on? Might this become a problem in the future?*

   As shown on the table above, the most rebates were distributed in 2010, 2011, and 2012 – a few years into the start of the program. Since then, the number of rebates has been declining, which suggests that it may become more difficult to find water savings via the rebate program as time goes on, at least in terms of what some call the "low hanging fruit" of residential fixture upgrades and efficiencies. *The Massachusetts Water Conservation Standards (July 2018)* states that Danvers intends to begin a program offering water-use audits to large water users in the commercial sector which could be a source of additional new water savings.
   .Danvers was asked by the Department of Environmental Protection to provide an estimate of withdrawals from the new developments in 2016 and 2017, as well as an estimate of the volume conserved or returned to the aquifer in those two years, and submitted the following information to the State:

…Please provide an estimate of withdrawals from the new developments in 2016 and 2017 as well as an estimate of the volume conserved or returned to the aquifer in those two years.

The estimated withdrawals in million gallons per year (MGY) from new developments in the 2016 and 2017 calendar year were 1.08 MGY and 2.5MGY respectively. The new daily demand on the system was 0.003MGD in 2016 and 0.007 MGD in 2017. The location of the new developments or redevelopments that began withdrawing water were all outside the Ipswich River Basin watershed and did not conserve or return water to that aquifer.

NATIONAL WUMP EXAMPLES:

Thorough research was conducted to ascertain whether the attributes of water use mitigation programs across the country could be a model for Ipswich. Other relevant example community models are summarized below.

Kern Water Bank Authority (KWBA), Bakersfield, CA

History: The Kern Water Bank (KWB) sits on approximately 20,000 acres in Kern County managed by the KWBA for the benefit of its members and their constituents, which include more than 400 farmers and tens of thousands of residents in the City of Bakersfield and the County of Kern. Prior to this, most of the 20,000 acres was used for farming. In 1988, the property was acquired by the California Department of Water Resources (DWR) for developing a groundwater storage facility called the Kern Water Bank.

- Public agency operating under a joint-powers authority
- Mission is to recharge, to store water surplus in wet years, and to recover water and use in dry years
- Large infrastructure/capital costs ($50m) – funded by member assessments (water districts, etc.), bonds and loans, commercial financing
- Operating costs – paid for by water banking revenue generated by charging the participants a cost per acre-foot of water recharged or recovered
- Currently, the Kern Water Bank project serves two primary purposes:
    - Water Banking (meaning water storage): The water banking operations include both recharge of underground aquifers for water storage in wet years and recovery of stored water in dry years. KWB uses recharge ponds where water infiltrates into the underground aquifer.
    - Wildlife preservation: KWB also operates a nationally recognized native plant and wildlife habitat conservation program that is restoring critical intermittent wetland and upland habitat to their natural state and protecting endangered species.

Scott River Water Trust, CA

History: The first active, public, water trust in California, obtaining its first water leases in 2007.

- It is a local, nonprofit, tax-exempt trust that compensates water users for providing water in reaches and at times of the year when instream flows are most needed by the fishery.
- Mission is to “improve stream flow in priority fish habitat reaches of the Scott River and its tributaries through the development of voluntary long-term and permanent water dedications with agricultural producers” (i.e. leases with farmers).
- Thus far, the Trust’s activities have been funded by the National Fish and Wildlife Foundation, PacifiCorp, The Nature Conservancy, NOAA-Fisheries, Bella Vista Foundation, and Dean Witter Foundation and a $30,000.00 grant from U.S. Fish and Wildlife Service. The eventual goal is to generate sufficient capital to develop a self-sustaining endowment fund (with expenditures deriving from the interest accrued on the principal).
- Note: a forbearance arrangement provides no assurances that the water will not be lawfully diverted by another water user downstream (or upstream) of the participant’s point of

diversion, rather than watch the water flow past the downstream participant's point of diversion. Forbearance arrangements only make sense where it is certain that the water will remain instream in the intended reach and this can limit the number of tributaries or stream reaches that are suitable for forbearance arrangements.

- The Trust had initially considered commencing the program with the purchase of water rights and land fallowing as opposed to water leasing. However, it was of the view that such an option will permanently remove water which hitherto, was available to the local agricultural producers. This will not only harm the local agricultural economy but also this will reduce any chances of getting the cooperation of the local agricultural producers. The purchase of water rights is an option that is still in consideration by the Trust.

San Buenaventura, CA

History: Planning began in 2013. The limited water resources available for new development exacerbated by a period of prolonged drought led to the institution of "water resource net zero fees" to enable the city to increase water production to serve and offset the demand of new or intensified development. Bank started in 2016.

- The water resource net zero fee is to be used to provide funds for projects to develop or acquire additional water rights or water resources to mitigate the added water demand caused by the new or intensified land development.
- The Demand Offset allowance of 2:1 is used for off-site extraordinary conservation measures while a 1:1 offset allowance is used for on-site extraordinary conservation measures.
- Ordinance No. 2016-004: Amended Division 22 'Public Utilities' of the San Buenaventura Municipal Code by the addition of "Chapter 22. 180, Water Rights Dedication, Water Resource Net Zero Fee and Water Resource Net Zero Requirements".
- https://ca-ventura.civicplus.com/DocumentCenter/View/6018/Ordinance-No-2016-004?bidId=

Cambria Community Services District (CCSD), CA

History: The CCSD Water Fixture Retrofit Programs are part of the Water Use Efficiency Plan adopted February 28, 2013.

- Mission: The program was started to conserve existing water resources, supplement and protect existing water supply, and increase water availability by regulating the water demands of new users.
- The Program aims to offset the expected number of Equivalent Dwelling Units (EDU's) of water to be used by each new structure. The in-lieu fee provisions established by the program allows for the collection of funds to accomplish the water savings through direct water conservation activities.
- Under this program, the District requires applicants for new construction projects to offset projected water use via plumbing retrofits in order to obtain water service (commercial or residential) and sewer connections. Applicants have the option to opt out of the plumbing

retrofit process, by paying fees to earn retrofit points from the CCSD points. Points represent water units (i.e. 1 point = .72 annual water unit or 1.47 gallons per day).

- Note that the county in which Cambria Community is located (San Louis Obispo County) has a County Growth Management Ordinance by which it places limitations on the country's growth and issuance of new construction. Due to concerns about Cambria's water availability, the County reduced Cambria's growth limit to 1% in 2000.
- The current growth rate set by the County for Cambria is 0%.

Water Conservation Program, Santa Fe, NM

Comprehensive water neutral program established in 2009. Requires that the impact of proposed new development be offset either through conservation in existing development or transfer of water rights to the city.

Water Demand Offset (WDO) Program in Soquel Creek Water District, Santa Cruz County, CA

History: Soquel Creek Water District receives 100% of its water from groundwater. The groundwater basin is currently in a state of overdraft leading to seawater intrusion. The District has been seeking a supplemental supply to address this problem and the Water Demand Offset (WDO) Program is a vital part of the District's conservation effort in the interim which ensures that the problem of seawater intrusion is not worsened by continued overdraft. Program was implemented in 2003.

- The WDO Policy (Resolution No. 17-24) requires the following development projects to offset approximately two times the amount of water they are projected to use so that there is a "net positive impact" on the District's water supply. Project applicants meet their WDO requirement by paying fees which are used by the District to fund conservation projects that reduce water use elsewhere in the District. The offset applies to:
    - Development projects requiring a new water service;
    - All new Accessory Dwelling Units, including those that are entirely contained within the existing square footage of an existing single-family home or accessory structure;
    - Development projects with an existing water service that are undergoing a change in use that is expected to increase water demand, as determined using District established water use factors; and
    - Existing commercial customers that are adding new square footage.

APPENDIX 8: IPSWICH WATER USE MITIGATION PROGRAM - DRAFT

TOWN OF IPSWICH
UTILITIES DEPARTMENT

272 HIGH STREET • IPSWICH, MA 01938 • (978) 356-6635 • FAX: (978) 356-6634

Ipswich Water Department
Water Use Mitigation Program

The Water Use Mitigation Program is implemented to mitigate water demand of new developments to minimize impacts to the water system. The funds collected through this program will fund water saving projects.

Program Administration

The Water Department shall be responsible for the administration of this program.

Applicability

This program will apply to development projects that represent a new or increased water demand and meet the following conditions:

- Residential projects of three (3) or more dwelling units
- All commercial projects

Requirements

All applicable projects must meet the following requirements:

- Comply with all applicable provisions of the state plumbing code
- All fixtures shall be energy efficient, water saving, and meet EPA's Water Efficiency Standards
- In-ground irrigation systems must be controlled by a rain and moisture sensing device

The domestic water and/or fire sprinkler service to the project will not be activated until the Town Plumbing Inspector has verified the project complies with these requirements.

Water Use Mitigation Charges

Charges shall be assessed to projects in accordance with the following fee schedule and are in addition to connection permit fees:

Project Type	Fee
Residential – 1 Bedroom	$1,000/unit
Residential – 2 Bedroom	$2,000/unit
Residential – 3 Bedroom	$3,000/unit
Residential – 4 Bedroom	$4,000/unit
Commercial	$5.00/gpd[1]

[1]Gallons per day volume to be defined per Title 5

The applicable Water Mitigation Program Form must be completed and submitted with payment to the Utilities Department Business Office prior to issuance of a building permit. The development plans and program form will be reviewed to verify the payment amount.

Should the payment not be paid prior to the issuance of the building permit or certificate of occupancy, the charges will be added to the customer's water bill.

Water Use Mitigation Program Fund

Fees collected under this program will accumulate in a designated Water Use Mitigation Fund established pursuant to M.G.L. Chapter _____.

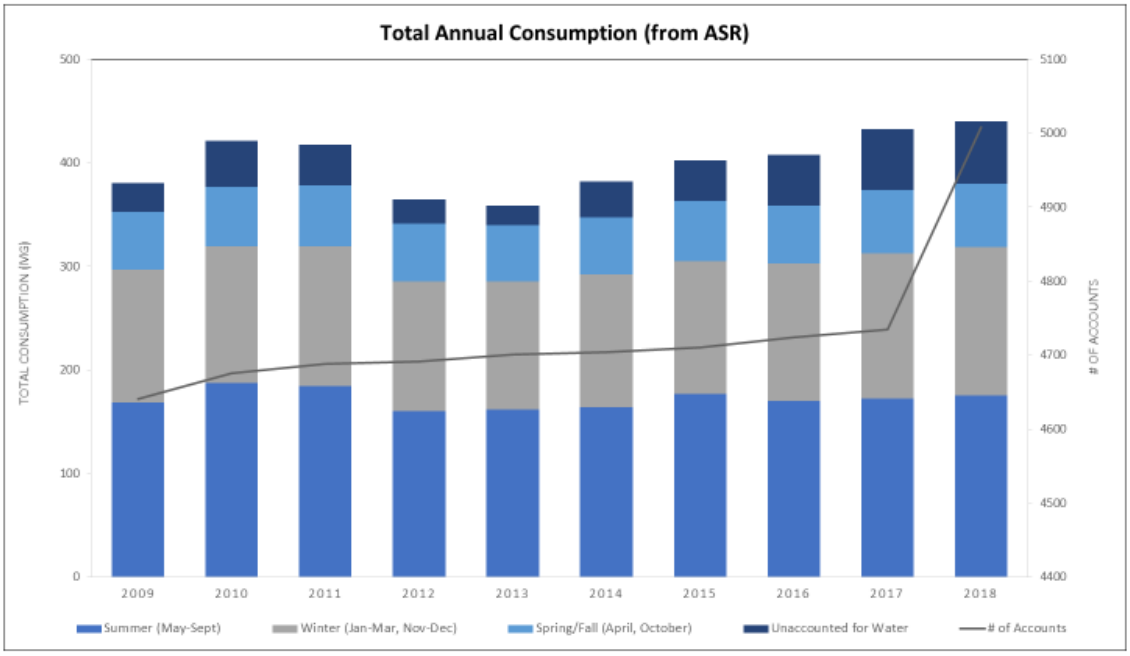
The Water Department may expend program funds for water conservation and/or water use mitigation purposes, in accordance with M.G.L. Chapter _____.

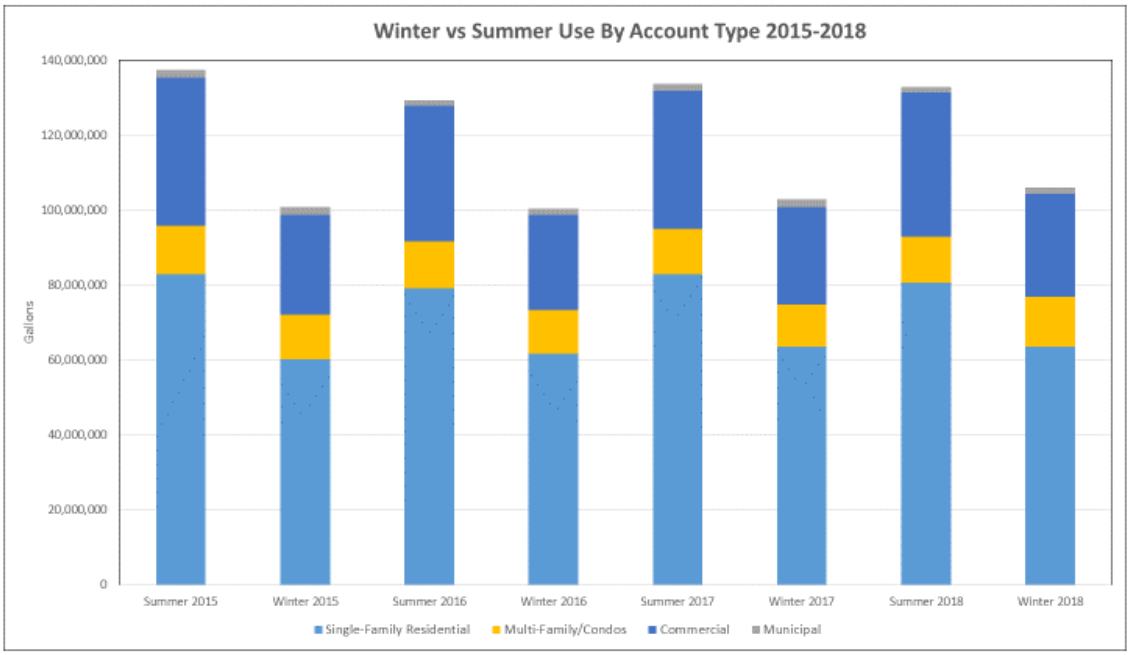
APPENDIX 9: TOWN OF IPSWICH WATER USE ANALYSIS, 2017 AND 2018

Town of Ipswich
Water Use Data Analysis
11/20/19

Data disclaimers:

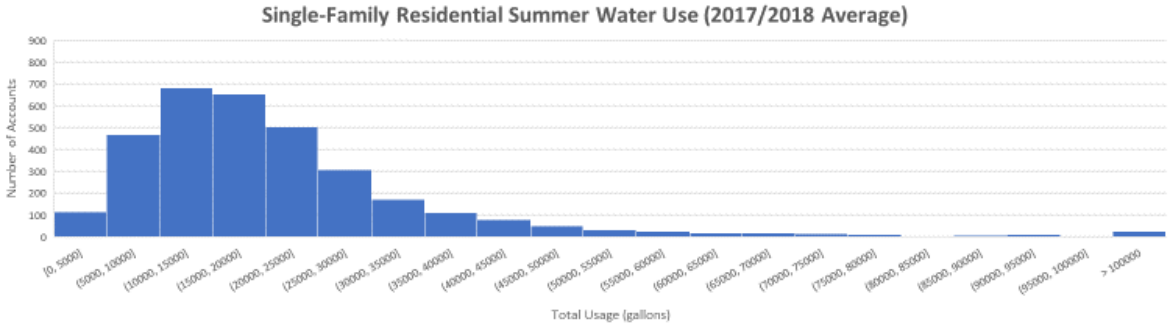
All data presented is an average of 2017 and 2018
Summer use is defined as May-September,
Winter use is defined as November-March
Discretionary use is calculated by subtracting total winter use from total summer use

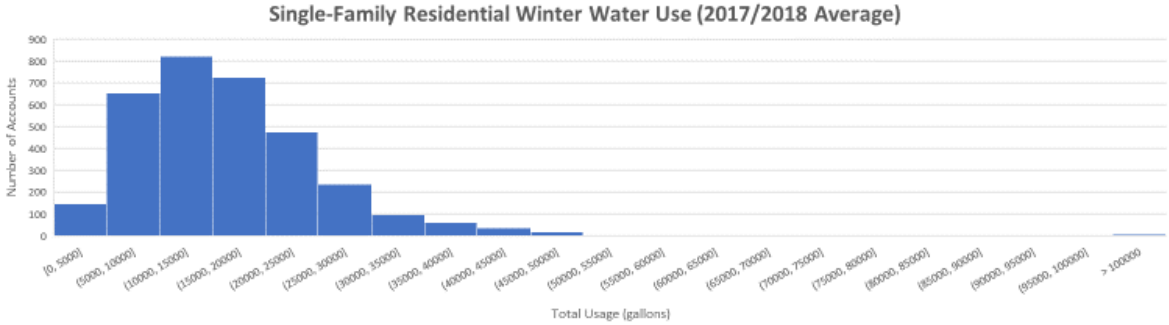


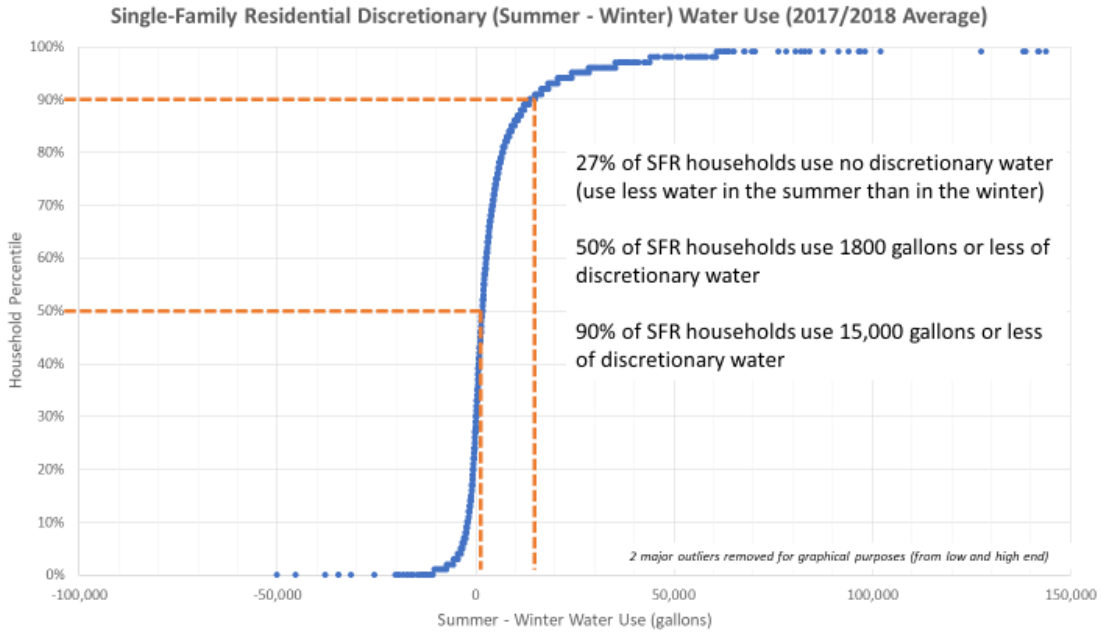


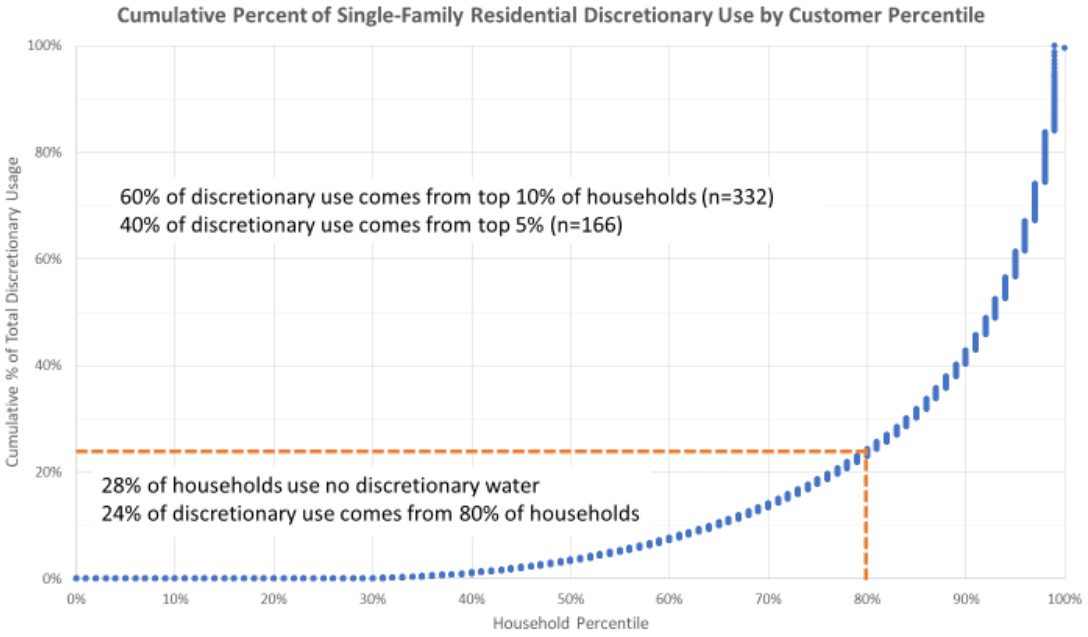
Single-Family Residential (SFR)

- Residential accounts represent 61% of total water use and 60% of discretionary summer (summer-winter) water use
- Residential data were screened for potential multi-family use (based on census data spreadsheet and customer name, such as condo)
  - Multi-family accounts that are not sub-metered were separated from SFR and are not included in this analysis
  - Minimal increase in winter to summer water use in multi-family
- Seasonal use was evaluated by looking at patterns of zero use and blank data
  - Seasonal accounts use 2% - 3.5% of SFR summer use


Single-Family Residential Summer Water Use (2017/2018 Average)
Number of Accounts
Total Usage (gallons)

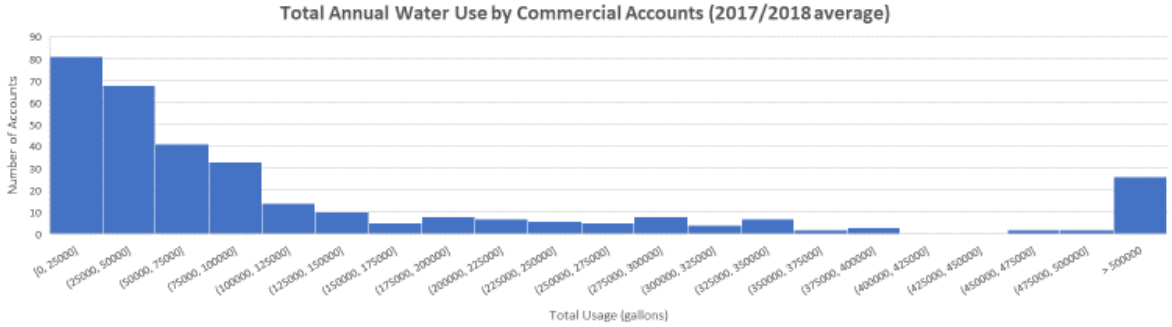

Single-Family Residential Winter Water Use (2017/2018 Average)
Number of Accounts
Total Usage (gallons)

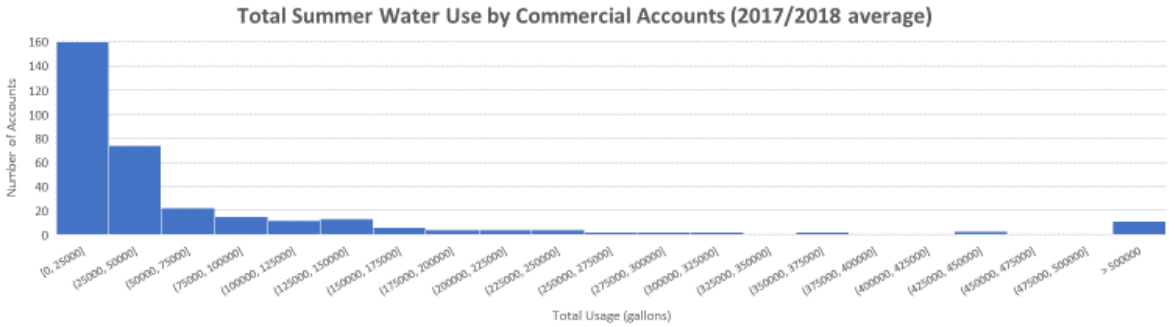

Single-Family Residential Discretionary (Summer - Winter) Water Use (2017/2018 Average)
Household Percentile
Summer - Winter Water Use (gallons)
27% of SFR households use no discretionary water (use less water in the summer than in the winter)
50% of SFR households use 1800 gallons or less of discretionary water
90% of SFR households use 15,000 gallons or less of discretionary water
2 major outliers removed for graphical purposes (from low and high end)

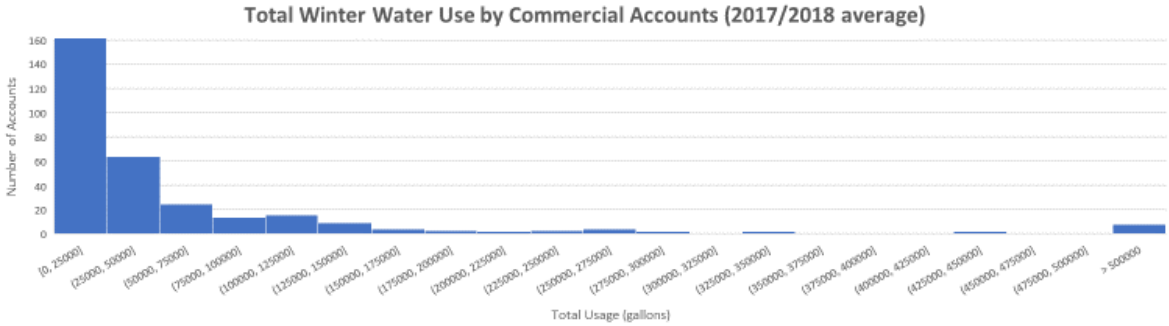


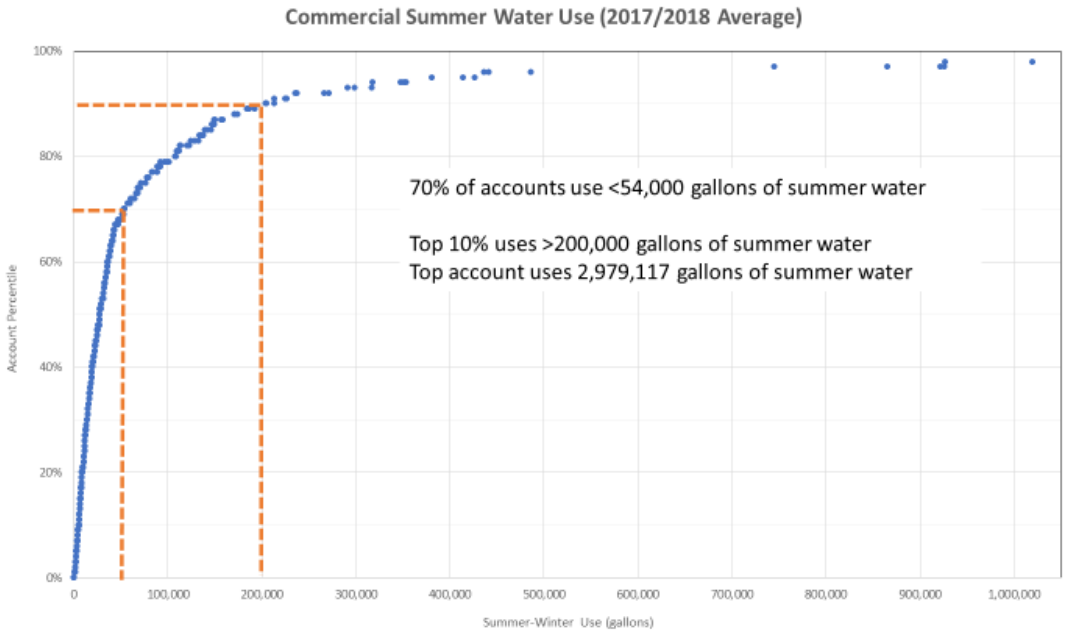
Commercial Accounts

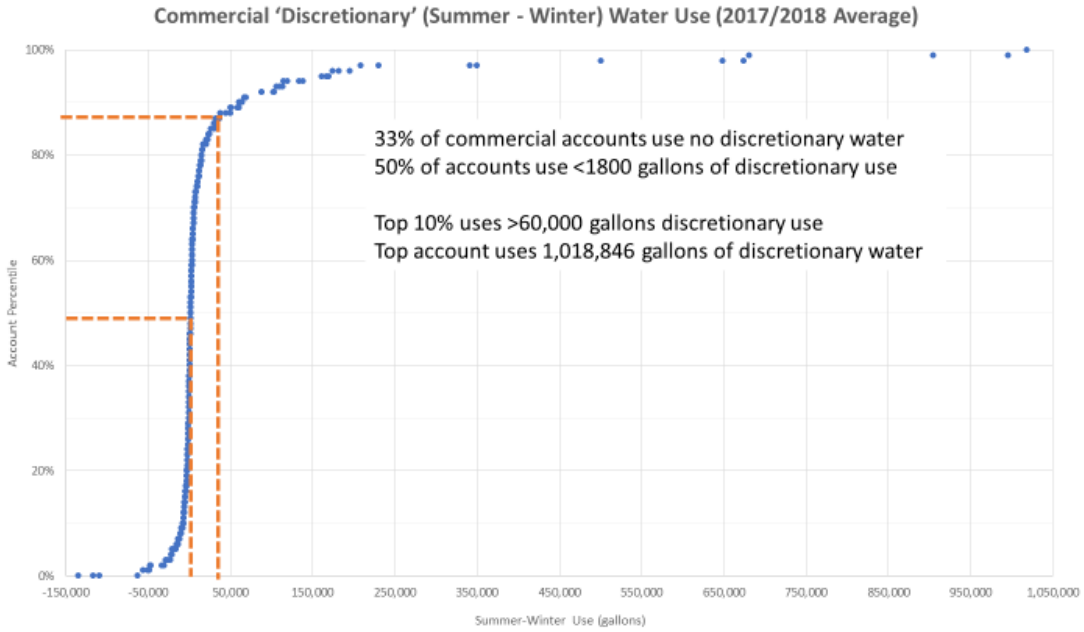
- Commercial accounts represent ~27% of total water use and ~39% of summer 'discretionary' (summer-winter) use
  - Summer discretionary use includes seasonal increases that are inherent in certain businesses and are not necessarily discretionary

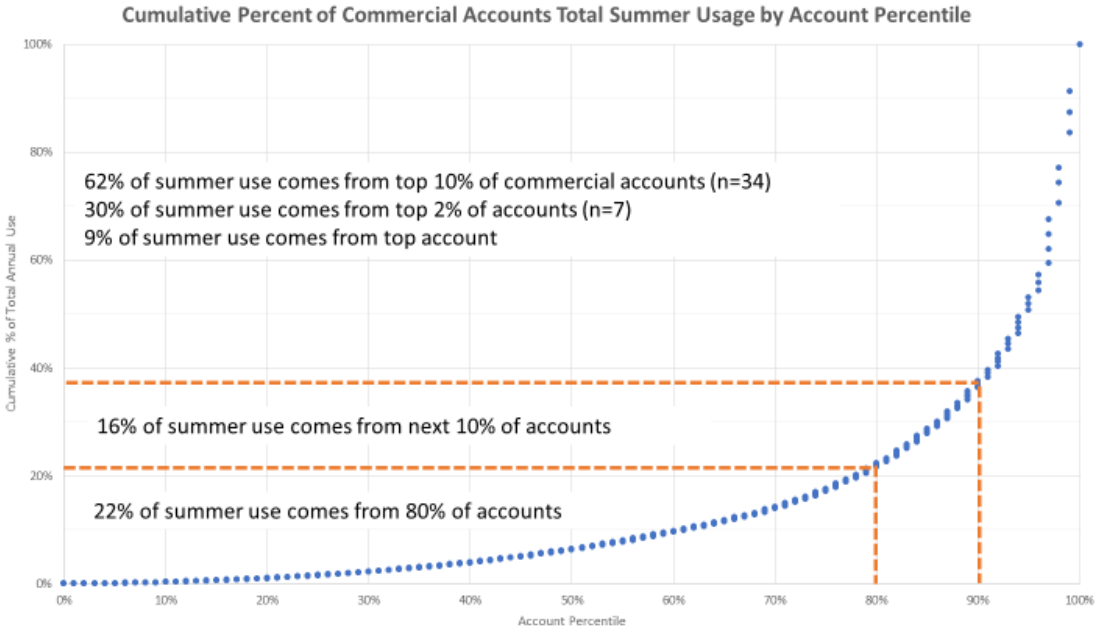


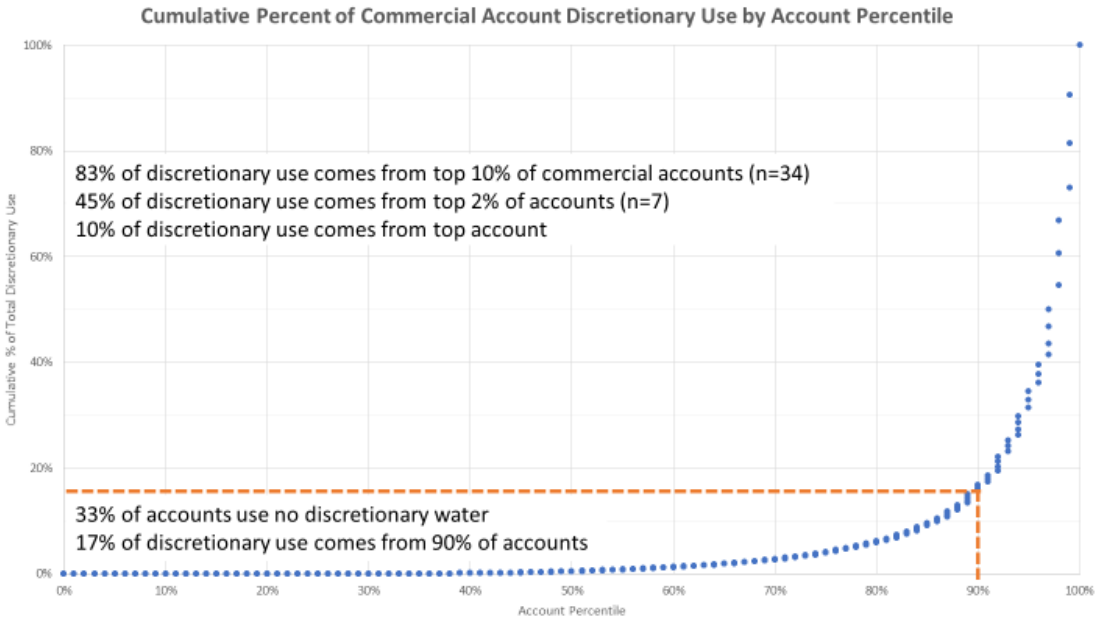

Total Summer Water Use by Commercial Accounts (2017/2018 average)
Number of Accounts
Total Usage (gallons)

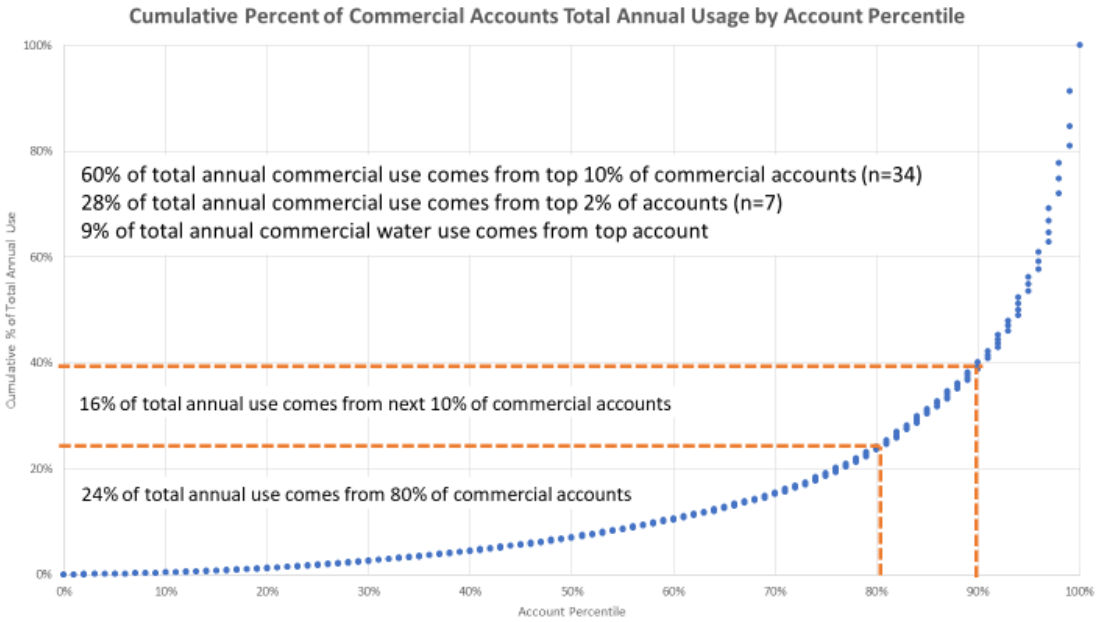

Total Winter Water Use by Commercial Accounts (2017/2018 average)
Number of Accounts
Total Usage (gallons)


Commercial Summer Water Use (2017/2018 Average)
70% of accounts use <54,000 gallons of summer water
Top 10% uses >200,000 gallons of summer water
Top account uses 2,979,117 gallons of summer water
Account Percentile
Summer-Winter Use (gallons)


Commercial 'Discretionary' (Summer - Winter) Water Use (2017/2018 Average)
33% of commercial accounts use no discretionary water
50% of accounts use <1800 gallons of discretionary use
Top 10% uses >60,000 gallons discretionary use
Top account uses 1,018,846 gallons of discretionary water
Account Percentile
Summer-Winter Use (gallons)
100%
80%
60%
40%
20%
0%
-150,000
-50,000
50,000
150,000
250,000
350,000
450,000
550,000
650,000
750,000
850,000
950,000
1,050,000


Cumulative Percent of Commercial Accounts Total Summer Usage by Account Percentile
62% of summer use comes from top 10% of commercial accounts (n=34)
30% of summer use comes from top 2% of accounts (n=7)
9% of summer use comes from top account
16% of summer use comes from next 10% of accounts
22% of summer use comes from 80% of accounts
Cumulative % of Total Annual Use
Account Percentile
100%
80%
60%
40%
20%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%


Cumulative Percent of Commercial Account Discretionary Use by Account Percentile
83% of discretionary use comes from top 10% of commercial accounts (n=34)
45% of discretionary use comes from top 2% of accounts (n=7)
10% of discretionary use comes from top account
33% of accounts use no discretionary water
17% of discretionary use comes from 90% of accounts
Cumulative % of Total Discretionary Use
Account Percentile
0%
20%
40%
60%
80%
100%
10%
30%
50%
70%
90%


Cumulative Percent of Commercial Accounts Total Annual Usage by Account Percentile
60% of total annual commercial use comes from top 10% of commercial accounts (n=34)
28% of total annual commercial use comes from top 2% of accounts (n=7)
9% of total annual commercial water use comes from top account
16% of total annual use comes from next 10% of commercial accounts
24% of total annual use comes from 80% of commercial accounts
Cumulative % of Total Annual Use
Account Percentile
0%
20%
40%
60%
80%
100%
10%
30%
50%
70%
90%

Total Annual Water Use (2017/2018 average)

Single Family Residential
Total Annual Water Use (gallons) - 2017/2018 Avg

	# Accounts	Median	Use Total	% Total Use (SFR accounts)	% Total Use (All Accouts)
Top account	1	5,053,465	5,053,465	3%	2%
Top 1%	59	173,286	17,869,802	10%	7%
Top 10%	412	92,317	50,378,359	29%	20%
Top 25%	999	68,679	86,623,013	50%	34%
Top 50%	1,978	53,622	130,088,729	76%	51%
All	3,917	36,714	172,030,090	100%	68%

Municipal
Total Annual Water Use (gallons) - 2017/2018 Avg

	# Accounts	Median	Use Total	% Total Use (Municipal Accounts)	% Total Use (All Accouts)
Top account	1	1,813,278	1,813,278	43%	1%
Top 1%	1	1,813,278	1,813,278	43%	1%
Top 10%	2	1,330,672	2,661,344	64%	1%
Top 25%	5	476,659	3,603,149	86%	1%
Top 50%	9	104,731	3,953,200	95%	2%
All	18	51,934	4,171,115	100%	2%

Commercial
Total Annual Water Use (gallons) - 2017/2018 Avg

	# Accounts	Median	Use Total	% Total Use (Commercial accounts)	% Total Use (All Accouts)
Top account	1	5,882,119	5,882,119	8%	2%
Top 1%	4	4,163,077	17,157,521	23%	7%
Top 10%	35	870,583	48,195,353	64%	19%
Top 25%	86	332,070	62,024,458	83%	24%
Top 50%	172	168,274	70,125,905	94%	28%
All	343	59,792	74,784,339	100%	30%

All Accounts
Total Annual Water Use (gallons) - 2017/2018 Avg

	# Accounts	Median	Use Total	% Total Use
Top account	1	5,882,119	5,882,119	2%
Top 1%	65	542,712	66,996,299	26%
Top 10%	453	111,280	114,907,699	45%
Top 25%	1,099	75,254	157,549,169	62%
Top 50%	2,176	55,975	206,792,143	82%
All	4,309	37,459	253,196,374	100%

Discretionary (Summer - Winter) Water Use (2017/2018 average)

Single Family Residential
Discretionary Summer Water Use (gallons) - 2017/2018 Avg

	# Accounts	Median	Usage Total	% Total Discretionary Use	% Total Summer Use (SFR accounts)	% Total Summer Use (All Account Types)
Top account	1	265,573	265,573	1%	0%	0%
Top 1%	34	81,401	3,157,292	17%	4%	2%
Top 10%	332	24,253	11,100,156	60%	14%	9%
Top 25%	829	11,124	15,216,611	83%	20%	12%
Top 50%	1,657	5,225	17,844,667	97%	23%	14%
All	3,316	1,653	18,437,883	100%	24%	14%
				Total Summer	77,461,894	129,401,418

Municipal
Discretionary Summer Water Use (gallons) - 2017/2018 Avg

	# Accounts	Median	Use Total	% Total Discretionary Use	% Total Summer Use (Municipal accounts)	% Total Summer Use (All Account Types)
Top account	1	277,340.26	277,340	78%	17%	0%
Top 1%	1	277,340.26	277,340	78%	17%	0%
Top 10%	2	164,375.00	328,750	93%	20%	0%
Top 25%	5	7,686.00	344,964	97%	21%	0%
Top 50%	9	3,740.26	353,354	100%	22%	0%
All	18	1,191.27	354,427	100%	22%	0%
				Total Summer	1,633,285	129,401,418

Commercial
Discretionary Summer Water Use (gallons) - 2017/2018 Avg

	# Accounts	Median	Use Total	% Total Discretionary Use	% Total Summer Use (Commercial accounts)	% Total Summer Use (All Account Types)
Top account	1	1,018,847	1,018,847	9%	3%	1%
Top 1%	4	950,045	3,599,888	31%	11%	3%
Top 10%	35	166,816	9,902,757	85%	30%	8%
Top 25%	86	37,565	11,168,431	96%	33%	9%
Top 50%	172	10,043	11,546,466	100%	35%	9%
All	343	1,792	11,589,288	100%	35%	9%
				Total Summer	33,379,204	129,401,418